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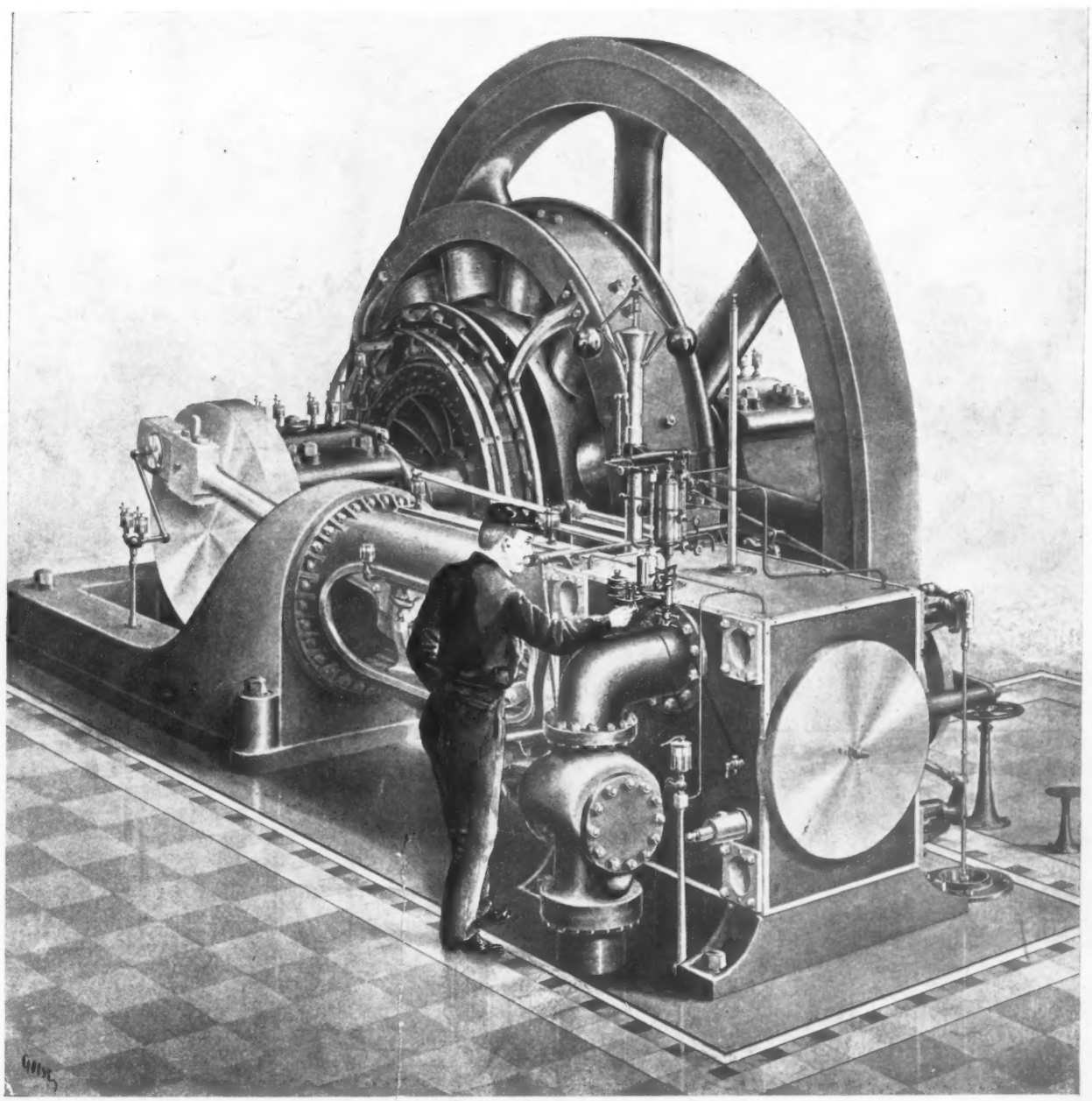

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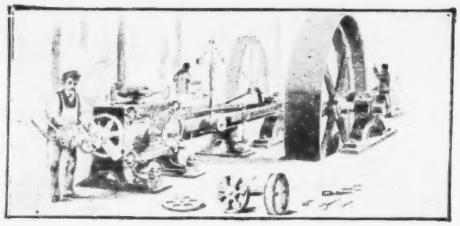

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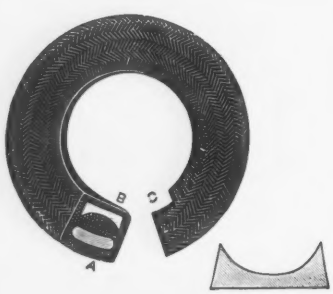

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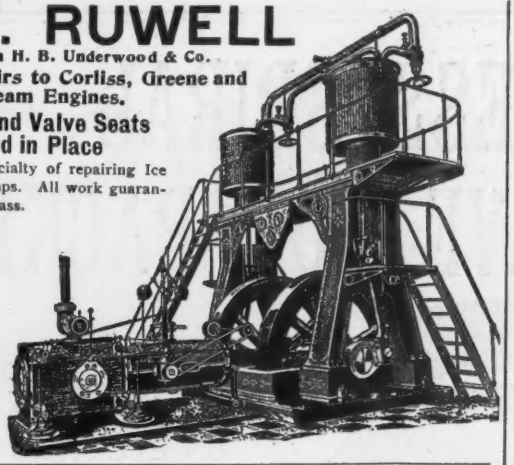

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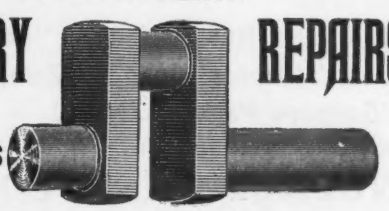

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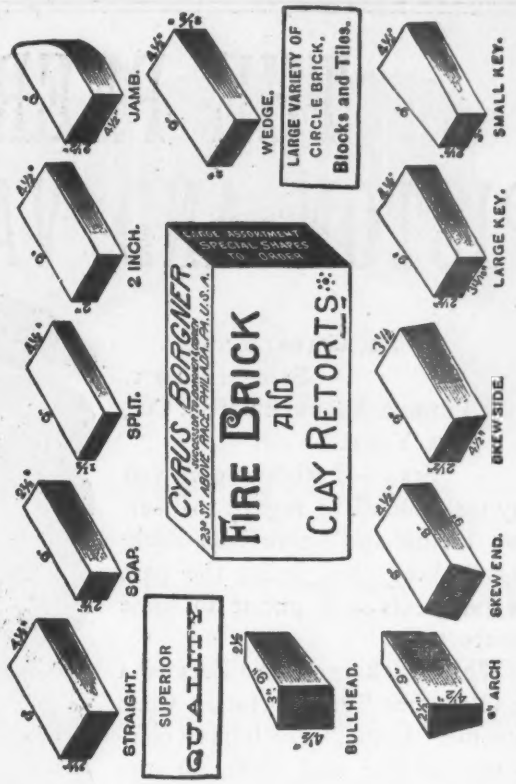

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The Practical Engineer

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Devoted to the Interests of Stationary Engineers.

VOL. VI PHILADELPHIA, JANUARY, 1903 No. 12

The Real Cause of Boiler Explosions?

Shortly following a recent disastrous boiler explosion, in which a number of lives were lost, there appeared in one of the leading daily papers, signed by one who described himself as "an engineer of long experience," an article which read in part as follows:

"It was undoubtedly caused by low water. This leaves the flues bare and they became hot, creating gas. When the flues reach a white heat they ignite the gas which explodes, and away goes the boiler. Thus the explosion is caused by gas and not by steam, as many people suppose. If the flues are bare and overheated, although not even red hot, and cold water is injected, it may help to form gas. The cold water circulates to the shell of the boiler and the air contained in the water goes direct to the flues which causes more gas and makes the situation critical. Steam never exploded any boiler in the world. You could not put steam enough in a boiler to cause an explosion."

It is well said "fools rush in where angels fear to tread."

The above theory will no doubt be of interest to engineers of "less experience," in as much as it evolves a question which has long been a subject of the deepest concern to the engineering world. Truly a "little learning is a dangerous thing."

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The Value of Catalogues

There is probably no engineer who has not had, at some time in his professional life, to take charge of an engine which was entirely new to him. This is also true of many of the appliances which he has been called upon to operate in connection with the plant. Yet there is scarcely one in a dozen who adopt the proper method of ascertaining the construction, purpose, economy or other points in connection with them.

As a rule the engineer knows a few days before hand where he is going to operate, and as a rule he will, if he does not know all about the different machines contained therein, spend those few days and nights in sleepless worry trying to decipher the ways and means of each appliance.

Now, there is where the great mistake occurs, if engineers desire to get acquainted with any device or obtain information concerning some particular engine, what is more easy than addressing a letter to the different manufacturers who each and all have printed matter descriptive of their several appliances, gotten up in a manner which will do more to initiate one into their intricacies than weeks of thought and work.

In response to a polite request, stating the circumstances, the makers will gladly furnish such matter free of cost.

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Humanity of the Trustees of Providence

The Commissioners appointed by the President must have, ere this, a pretty clear idea of the type of men who, according to President Baer, constituted the Trustees of Providence to distribute coal. If they have not yet formed an opinion,an instance which occurred a few days ago will no doubt enlighten them considerably upon the way in which these same trustees execute their trust, and also it will show the type of men who predominate in labor unions.

In an obscure news paragraph, a few days ago, was recorded one of the oddest achievements of labor unionism, a successful sympathetic strike inspired by the most unselfish motives. Three hundred Indiana coal miners struck to force the company to feed the mine mules properly and give them decent care. The mules were neglected and ill-treated, but they could not make known their grievances, and so the Union took up their cause and insisted that the four-foot laborer was as worthy of his hire as any other, and entitled to a fair share of the product, that share being

enough to eat and attention to his needs. The company was indifferent to the appeal, the miners went on strike and the strike was not declared off until the company promised to take proper care of the mules. But for the organization of labor, the welfare of the miner and the mule, would get about equal consideration from those to whom Providence has given control of the property interests of the country.

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Ignorance of the Control of Steam Energy

Boiler explosions occurring during the past two months in such frequency, and with such fatal results, has caused practically unlimited criticism in our trade journals, each advancing their several reasons for the disasters. This time, one year ago, the country was equally concerned over a like series of explosions; and so it has ever been for years—each November and December being productive of a majority of the fatalities, in this line, for the year. That this is true is no doubt due, largely, to lack of feed-water heaters, insufficient pipe and boiler coverings, the sudden freezing up of the water supply, or some similar action caused by an unlooked for, and usually unprepared for, drop in the temperature.

Of course, we might say that any engineer would know at once if his feed-water inlet, or pump was frozen, but, there are numerous instances where engineers do not have the care of the boilers, which are left in charge of incompetent firemen or others who know little more than how to turn on the water. Thus we have an explanation, in part at least, for some of the boiler accidents at this period of the year. But, in order to thoroughly appreciate the enormous forces stored up in a boiler, one should have an idea of the power directly proportioned to the weight of water and of steam which the boiler contains.

A steam boiler is not only an apparatus by means of which the potential energy of chemical affinity is rendered actual and available, but it is also a storage reservoir, or magazine, in which a quantity of such energy is temporarily held; and this quantity is always enormous. The energy of gun-powder is somewhat variable, but a cubic foot of heated water under a pressure of 60 or 70 pounds per square inch, has about the same energy as one pound of gun-powder; at a low red heat it has about forty times this energy.

Now unless one thoroughly understands these facts he is not in a position to appreciate what his boiler requires to keep from attaining a low red heat. Furthermore in the operation of boilers the cause and effect must be understood by the attendant before he can give intelligent attention to his work.

Heat turns water into steam and the more steam there is made and confined, the greater the pressure will be. If the steam is constantly flowing from boiler to engine, the pressure in the boiler must be kept up by continually making new steam to take the place of that drawn off. If we make steam as fast as it is used, and no faster, the pressure remains the same. If we make it faster than it is used, it blows off through the safety valve when reaching the point at which valve is set to let go; and if we do not make it as fast as used our pressure decreases. These conditions are generally understood, but often in a vague sort of way. To insure safety, the attendant must understand each condition and its requirements, and to be able to meet these requirements, no matter how variable, at once.

It is a question long since settled that a boiler designed and properly built to withstand a pressure of 150 pounds is as safe as a boiler built to carry a pressure of 80 pounds at their respective pressures. But all the care in the world exercised in the selection of material and &c., cannot recompense for the ignorance of the manipulator.

That this is generally recognized is the cause of license laws being enacted in our more thickly populated districts, but until our law makers realize that a boiler in an obscure or isolated factory contains the same energy at 100 pounds pressure that the same boiler would in a large city, we may still look for the usual quota of fatalities from boiler explosions.

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Predominating Elements in Estimating Horse-Power

As a moment's reflection will readily reveal, the elements entering into the estimate of an engine's horse-power are the effective temperature of the steam, as indicated by the mean pressure throughout the stroke; the contents of the cylinder, as indicated by the length of the stroke and the area of the piston, and the number of revolutions per minute. The product found by multiplying these factors will give the number of foot-pounds made available, which expression, divided by 33,000, gives the indicated horse power.

The denominator, 33,000, expresses the number of foot-pounds per minute in a horse-power. Thus, a horse-power is such a force as can lift a weight of one pound through 550 feet in each second, or such as can lift a weight of 550 pounds through one foot in each second. This force constantly exerted through one minute, or sixty seconds, can lift 33,000 pounds through one foot, or one pound through 33,000 feet. Since, however, the action involves motion, it is cumulative in both time and space; requiring an increased area of operating surface, or an increased length of time, or both, to accomplish work in excess of the figures given. Thus, an engine exerting precisely one effective horse power can raise 10 pounds through only 33,300 feet per minute, or 55 feet per second, and requires 10 minutes, or 600 seconds, to raise 330,000 pounds through the vertical distance of one foot. To so enlarge the capacity of an engine that it can do ten times the indicated amount of work in a given space of time, or so that it can do the indicated amount of work in one-tenth that given time, involves that the cubic content of its operating chamber, or cylinder, be proportionally increased in order that ten times the amount of steam may be utilized in a given time, or for the accomplishment of a given work at each stroke of the piston. For it is evident that a mean effective pressure of 45 pounds per square inch means 90

pounds available pressure with a piston area of two square inches; 180 pounds available pressure with a piston area of four square inches, and 22.5 pounds available pressure with a piston area of ½ square inch.

On the basis of these evident principles, two simple rules may be derived for calculating the indicated horse-power. This, however, is always in excess of the actual efficient horse-power, as will be subsequently explained. While there are numerous formulæ for determining this point, one of the most familiar is as follows:

(*a*) Find the area of the piston by multiplying the square of a radius in inches by 3.14159 (ratio between circumference and diameter).

(*b*) Find the pressure in pounds on the piston by multiplying the area by the mean pressure per square inch.

(*c*) Find the length in feet traveled by the piston per minute, by multiplying the length of the stroke in feet, or fractions of a foot, by twice the number of ascertained revolutions of the crank shaft per minute. This equals the number of strokes per minute for a double-acting cylinder.

(*d*) Find the foot-pounds available during the given space of time (one minute) by multiplying the pressure, in pounds, by the length traveled by the piston, in feet.

(*e*) Find the I. H. P. (indicated horse-power) by dividing this last product by 33,000.

The formula is: $\frac{PLAN}{33,000} = I.\ H.\ P.$

P being equivalent to the M. E. P. (mean effective pressure) in pounds per square inch.

L being equivalent to the length of the stroke in terms of feet.

A being equivalent to the area of the piston in square inches.

N being equivalent to the number of strokes of the piston, or twice the number of revolutions of the crank-shaft, per minute.

The element of speed, as expressed in terms of strokes, or revolutions, per minute is important, and fundamental, in estimates on power, since, as must be evident from what has already been said, the superior power-capacity of one engine over another consists principally in being able to do, for example, ten times the work in a given time, or to do the same work ten times as fast. Therefore, an engine that can propel a given mass and weight of machinery at 300 revolutions of its crank-shaft and fly-wheel per minute, is evidently three times more powerful than another engine which can move the same mass and weight of machinery at only 100 revolutions per minute. Consequently, in forming the expression for the horse-power ratio of any given engine, the other essential factors of the numerator are to be increased, as the number of times per minute the engine performs its complete cycle.

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Don't be afraid to let your partner handle your tools, he won't hurt them much. I have known engineers to have a fist fight over a small chisel that had not the intrinsic value of a dime, at the same time I know he has as good a right to furnish tools as you, but then there will be lots of tools when we have all cashed in our chips.

The Effect of Clearance

By R. T. Strohm.

It is wholly impossible to build an engine which shall be free from the wear due to friction, and as this wear shows itself it becomes necessary to tighten up the worn parts in order to restore them to their proper relations. Especially is the effect of friction liable to show itself in the bearings at the crank-pin and the cross-head pin or wrist-pin. For this reason the brasses at the ends of the connecting-rod are made with adjusting devices, so that as they wear the lost motion may be taken up easily and quickly, and the rod restored to its original length.

This wear, however, cannot be taken up except at intervals, and for that reason it is necessary to allow a certain distance between the piston at the end of its stroke and the nearer cylinder head, which is termed clearance. By this means the brasses may be quickly tightened to prevent pounding, without much regard as to whether the connecting-rod is the same length as before or not, since any slight alteration of its length will simply make the clearance unequal at the opposite ends of the cylinder. This inequality will not be of any consequence in so far as the effect upon the action of the engine is concerned.

There is another point which necessitates a certain amount of clearance between cylinder head and piston. The main bearings of the engine, like the crank-pin brasses, are subject to wear, and as they wear the centre of the engine shaft falls below the centre line of the cylinder. This in itself tends to make the piston approach nearer to the crank end than the head end, and to avoid striking the head with disastrous consequences, clearance must be provided.

There is a further argument for the necessity of clearance in a steam engine cylinder. The steam which is supplied to the engine is seldom dry, and still more frequently it is decidedly wet. Even if the steam had been superheated when entering, the loss of heat which it would have sustained due to the cooling effect of the cylinder walls and piston, together with the condensation due to expansion, would have left wet steam in the cylinder at the ends of the stroke. Now, water is practically incompressible, as many an unfortunate engineer can testify after trying to compress it between the piston and cylinder head of a running engine. The second value of clearance, therefore, is to provide a space in which the water caught during compression may safely remain during the remainder of the stroke, without any danger of a broken piston or cracked cylinder head. But even with clearance it sometimes occurs that a slug of water will come over from a badly priming boiler and wreck the cylinder. This, however, cannot be blamed upon insufficient clearance, but upon lack of foresight in not placing a separator in the steam pipe to prevent water from entering the cylinder altogether.

The word clearance has two distinct meanings, which are wholly different from each other. The term may mean either a distance or a volume. For that reason we say that clearance is of two kinds; namely, piston clearance and engine clearance. In speaking of clearance,

then, it is necessary to specify just which kind of clearance is meant, to prevent any possibility of error.

Piston clearance is the distance, measured in fractional parts of an inch, between the face of the piston and the nearer cylinder head when the crank is on dead centre. That is, when the piston is at the end of its stroke. It varies according to the size and speed of the engine, ranging from $\frac{3}{16}$ to $\frac{1}{2}$ of an inch.

Engine clearance, on the other hand, is the volume of the space between the cylinder head and the piston when the latter is at the end of the stroke, nearer the head in question, plus the volume of port, up to the face of the valve, which leads into the space mentioned. In other words, it is the total volume of the space included between the face of the valve and the face of the piston when the crank is on dead centre. This clearance is measured in cubic inches, but is not represented as such. The most common way is to express it as a percentage of the volume swept through by the piston during one stroke from end to end of the cylinder.

For example, suppose a cylinder to be 20 inches in diameter and have a length of 24 inches, and let the volume of the clearance space be 603 cubic inches. During one stroke the volume which would be swept through by the piston would be 7540 cubic inches. Then the clearance volume is $\frac{603}{7540}=\frac{2}{25}$ of the volume of the piston displacement, or 8 per cent. Consequently we say that the engine has 8 per cent. clearance.

The amount of clearance varies greatly with the speed and the type of the engine. For slow speed engines, such as the Corliss type, the clearance is very low, ranging from a fraction of one per cent. to 3 or 4 per cent. In the high speed automatic engine there is necessity for greater clearance, and for that reason a clearance as high as 12 or 14 per cent. is not uncommon.

Clearance in an engine cylinder is a necessary evil. To obtain the most economical results with the ordinary engine the clearance should be zero. That is, the piston should move from cylinder head to cylinder head. This is, however, an impracticable condition, and so we must do the best we can by making the clearance a minimum.

It would be possible to counteract the effect of the clearance by expanding down to the back-pressure line, and compressing up to the initial pressure on the return stroke, but such a procedure is not practicable. The clearance steam, or the steam which fills the clearance space at cut-off, does work during expansion, but at release it is exhausted and only a small amount is saved by compressing it to about half the initial pressure, so that at each stroke it becomes necessary to fill the clearance with live steam. Without clearance, the amount of steam used per stroke would be the volume swept through by the piston up to the point of cut-off. Clearance adds to the steam consumption. If compression were carried up to the initial pressure, the clearance at admission would be full of steam at the initial pressure, and so there would be needed only sufficient live steam to fill the cylinder up to the point of cut-off.

Clearance likewise has an effect upon the point of cut-off. Assume that we have an engine whose cylinder is 24 inches in diameter, and whose stroke is 36 inches. If, by observation and measurement, we found that the piston had moved 9 inches from the end of its stroke when cut-off took place, we should at once say that the engine cut off at quarter stroke. That is, the piston completed a quarter of its stroke before the valve cut off steam. This is known as the apparent cut-off.

There are two kinds of cut-off, however, if such a phrase be allowable. The apparent cut-off has just been defined. The other is the real cut-off. The real cut-off takes into account the clearance volume in the cylinder, and is the point of cut-off which should be used in all calculations which make any pretense of accuracy.

To show the difference between real and apparent cut-off more clearly, let us have recourse to an example. Assume an engine 20 inches by 30 inches, with a clearance of 10 per cent., and suppose that the piston moves 6 inches from the end of its stroke before cut-off occurs. Let us first neglect the clearance. The apparent cut-off

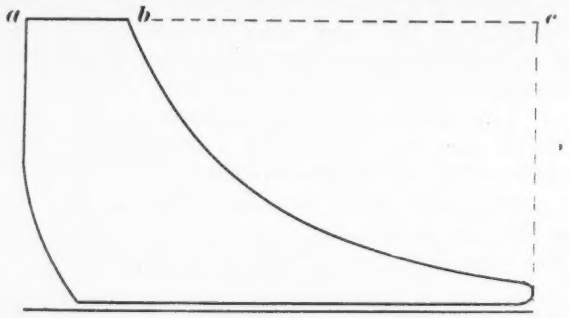


FIG. 1

is $\frac{6}{30}=\frac{1}{5}=.2$. Figure 1 illustrates this cylinder, neglecting clearance. In this figure, *ac* represents the length of the stroke. The piston moves through one-fifth of its travel before cut-off occurs. That is, $ab=\frac{1}{5}\ ac$, the point *b* being the point of apparent cut-off. But on an indicator diagram, distances along the line *ac* may be taken to represent volumes. The volume at the point of cut-off *b* is denoted by *ab*, which represents the volume of a portion of the cylinder 6 inches long. That is, a volume of 1884.96 cubic inches. The volume at *c* is denoted by *ac*, which represents the total volume of the cylinder, or 9424.8 cubic inches. That is, the ratio of the amount of steam in the cylinder at cut-off to the amount at the end of the stroke is $\frac{1884.96}{9424.8}=\frac{1}{5}$, which is the ratio representing the apparent cut-off. In other words, we can define the apparent cut-off as the ratio between the volume of steam in the cylinder at the point of cut-off to the volume at the end of the stroke, no clearance being considered.

The real cut-off is the ratio of the volume of steam in the cylinder at cut-off to the volume at the end of the stroke, both volumes including clearance. Let us use the same cylinder as before, but let us take into account the 10 per cent. clearance.

The volume of the cylinder, as found, is 9424.8 cubic inches. The clearance is 10 per cent., or one-tenth of this, or 942.48 cubic inches. Then the volume at cut-off is actually $1884.96+942.48=2827.44$ cubic inches; and the volume at the end of the stroke, including clearance, is $9424.8+942.48=10367.28$ cubic inches. Therefore the real cut-off is $\frac{2827.44}{10367.28}=.273$, as compared with an apparent cut-off of .20. The real cut-off will always be later than the apparent cut off.

STEAM ENGINE DESIGN

By A. EDWARD RHODES, Author of "Mechanical Drawing for Self Instruction."

In steam engine, as in all other machine design, there are certain parts whose proportions may be determined from existing rules or formulas, which have been gathered from various sources, and proven to be correct by many tests. Many engineers think that to find the correct dimension of any one part of their engine requires an amount of skill far beyond that of the average engineer, I do not believe that such is the case, and will give all the formula needed or used by the average steam engine designer, and I believe, in a way that can be understood and *worked out* by any engineer who really wants to. Please Mr. Technical man, don't understand me to mean that there are no formulas requiring higher mathematics, for I know that there are books full of them, but they are only for finer calculations than are absolutely required when designing a slide valve engine.

How often we hear the expression, "A 50 horse-power engine." Those of us who have to do with steam engines know very well that such a term is meaningless so far as size etc., is concerned, unless it is accompanied by additional information, as, the steam pressure, number of revolutions, point of cut-off, and so on. Therefore when I say that the model engine illustrated is a half-horse-power engine, and its piston is 1¾ inches di-

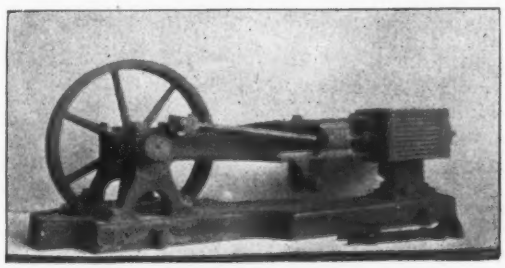


FIG. 1

ameter, and that the engine has a stroke of 3 inches, I must necessarily mean that it develops one-half of a horse's power, only under certain conditions. I believe there is not an engineer but what knows all of this, yet dozens of them speak of so and so's engine as a so many horse-power engine, rather than say its bore is so many inches diameter, and has a stroke of so many inches.

The little engine illustrated herewith has been built by boys of an age averaging about 15½ years. What they have done so can you. It is intended to so show the parts that any engineer can make the drawings and from them make the engine. Some will say, Oh, but I haven't the time! others I have no machine shop, and then there are those who believe that if there is a will it can be done. Possibly the members of some Council may want to club together and each one make one or a few parts.

Engines so small as the one we want to build are not built for or intended as economical users of steam. Therefore, there is no formula for proportioning the various parts. This leaves us simply our judgment to depend upon.

Figure 1, is a photo taken from in front of the engine, the guide-plate being removed so that the cross-head connections and piston-rod stuffing box may be the more clearly seen. Figure 2, is looking towards the en-

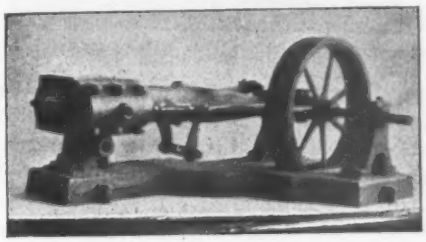


FIG. 2

gine from the back. Figures 3 and 4, show the cylinder and frame as it will look when finished. The inside cylinder head, which is of brass and also forms the piston-rod stuffing box is also shown in Figure 3. It is finished all over, forced into the cylinder and riveted, or caulked on the outside. Figure 5, shows the guide plate, crank-shaft brasses, the piston-rod stuffing box gland, and the cap for the crank shaft bearings.

The important measures are marked on the drawings; Figure 6, as are also, the letters of reference required for the formula for larger engines.

The cylinder and frame are two important parts of any engine, in this case they are made in one casting, and are by far the most difficult parts to make.

The principal dimensions of the cylinder for a slide valve engine may be determined from the following proportions. For convenience we will assume that we are calculating the sizes for a 12-inch diameter engine, and a steam pressure of 100 pounds per square inch. Let D equal the diameter of the cylinder—then the length of it will be, the length of the stroke plus thickness of piston, plus twice the piston clearance.

The counterbore at each end should be just enough to

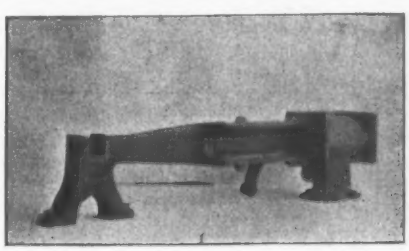


FIG. 3

leave about ¼ to ½ of the outside packing ring of nearest end of the piston, overtravel the bore of the cylinder. The counterbore serves two purposes, it prevents the piston wearing a shoulder at each end of the cylinder, and allows reboring of the cylinder without making new cylinder heads.

The cylinder walls A must be strong enough to resist the greatest steam pressure that may at any time be confined within the cylinder, and also thick enough to

allow for reboring when the cylinder becomes worn. A good general rule is:

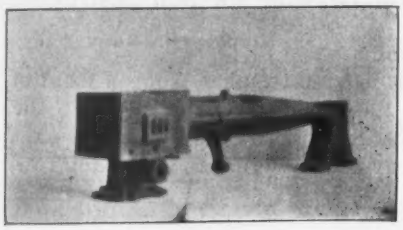


FIG. 4

Boiler pressure times diameter of cylinder times .0003 to which add .4-10.

Illustration: Our pressure is 100 pounds per square inch, and the cylinder is 12 inches diameter.

Then: 100 x 12 = 1200, and 1200 x .0003 = .3600.

Now .3600 + 4 = .7600 or about ¾ of an inch, which is the average thickness of cylinder walls for engines of 12 inch bore. The flanges B may be made about 1½ times the thickness of the cylinder walls. The diameter of the flanges should be made to suit the bolts or studs, whichever is used.

The distance from centre to centre of cylinder head bolts or studs varies from 4 to 6 inches. I think they should never be more than 5 inches apart.

To find the diameter of bolts or studs for cylinder heads, you must first find the area thus: The net area of a single cylinder head bolt whose nominal diameter is $C = \frac{A\ P}{4{,}000\ N}$

When A=The area of cylinder head in inches.
P=The steam pressure.
N=The number of bolts.

11,300 ÷ 24,000 = 47 or ½ inch nearly, but as it frequently happens that the pressure in the cylinder is much greater than the boiler pressure, due to entrained water, etc., some allowance must be made in the size of the bolts. This may be done by adding a factor of safety to the formula as given; that is, by increasing P in the formula to what is supposed to be, or known to be, the greatest possible pressure that may at any time be in the cylinder. This will increase the diameter of the bolts to ⅝ or ¾ of an inch, depending entirely upon the fancy of the designer. The dimensions of the steam and exhaust ports, in fact all steam passage ways, must be large enough to allow the steam to follow the advancing piston without loss of pressure. In the average engine the velocity of the steam is about

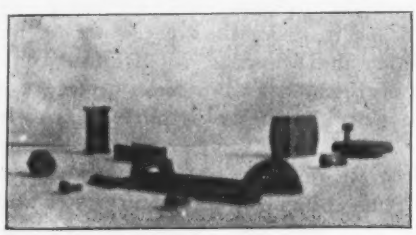
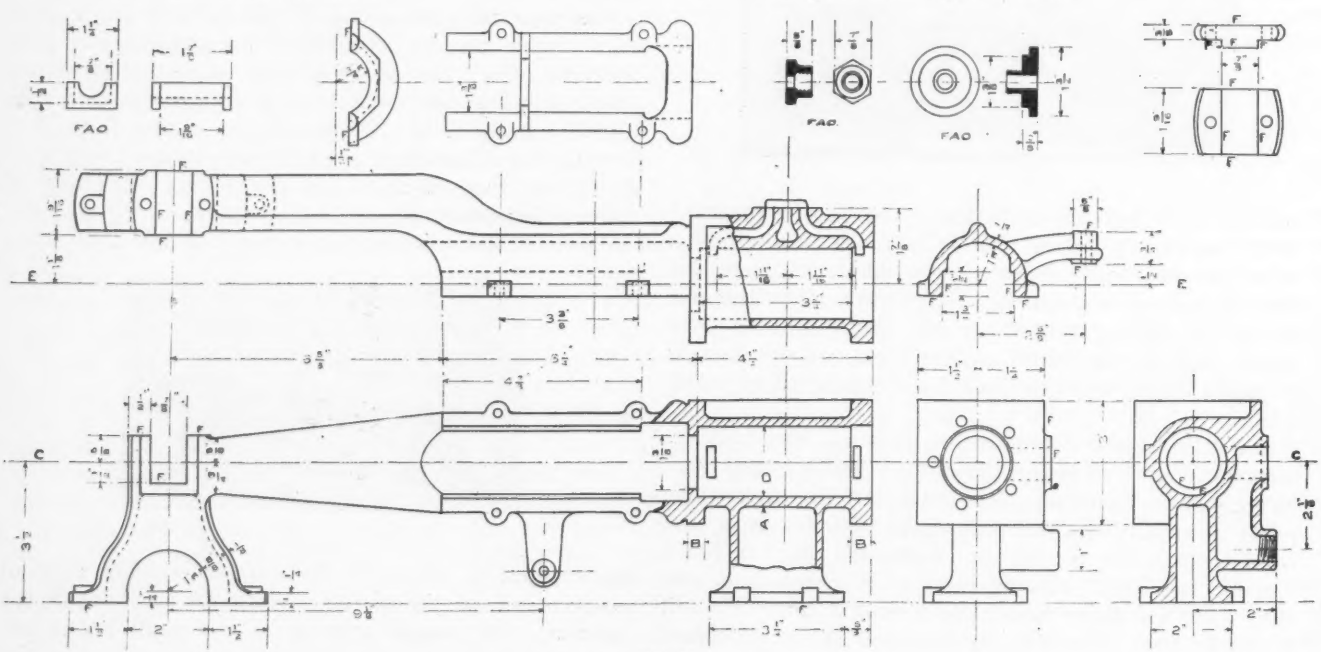


FIG. 5

100 feet to 125 feet per second. There are many formulas for determining the size of the steam ports, one that I now copy from a text-book is:

Let L = length of port in inches.
B = breadth of port in inches.
A=area of piston.
S=piston speed per minute.
V=velocity of steam per second.



PLAN

Illustration: A or area of 12 inches is 113 sq. inches.
P or pressure is 100 lbs. per sq. inch.
N or for convenience 6 bolts.

Then 113 x 100 = 11,300, and 4,000 x 6 = 24,000. Now,

Or, L B V = A S.
And, $\frac{A\ S}{V} = L\ B$.

The constant 100 may be used for V when designing a plain slide valve engine. To find size of ports for

over 12 inch diameter engine if its piston speed is 10 feet per second. The area of 12 inches equals 113 square inches. Then A S or 113 x 10 = 1130, which divided by V or 100 = 1130 ÷ 100 = 11 3-10 inches for the area of the steam ports. The length of the steam port may be 7-10 x D or 7-10 x 12 = 8 4-10 inches, say 8½ inches long. The width will be such that, it multiplied by the length will equal the area. The area of the exhaust ports may be 1¼ to 2¼ times the area of the steam port. The area of the steam and exhaust pipes should be equal to their requisite ports.

The distance from centre of cylinder to valve seat must be such that the area of the most contracted part of the exhaust port is not less than that of the steam port.

To make the drawing, refer to Figure 6.

1st. Draw a horizontal centre line C, for the front view about 6 inches from the bottom of your paper. From it lay off and draw the cylinder, guides and box, or pedestal for the crank shaft brasses.

2nd. Now build on the cylinder walls and draw the frame. Then locate centre and draw the rocker arm bracket.

3rd. Draw the horizontal centre line E for the top view 4¼ inches above the line C. Then draw the cylinder, the ports, the guides and lastly the frame.

4th. Draw the end and the two sectional views.

5th. Draw the crank shaft brasses to the sizes given. There are two of these boxes, each bored ⅝ of an inch, finished all over, and with an oil hole in the top half.

6th. Draw the guide plate, it is of cast iron finished on the inside, and drilled for four 3-16 of an inch tap bolts. The corresponding holes in the frame are tapped to receive these bolts.

7th. The inside cylinder head piston rod stuffing box and its gland is shown in solid section, an expedient often resorted to when the object to be represented is small. The head is bored 5-16 of an inch to fit the piston rod, turned 1¾ and 1⅜ inches diameter to fit the cylinder. The 1¾ and 1⅜ inch diameters are each 3-16 of an inch thick. The screw part for forming the stuffing box is 9-16 of an inch diameter by ½ of an inch long. The gland or nut is made to fit it and has a hexagon on it (as shown) for screwing the packing tight. Both are made of brass and finished all over. The head being forced into the cylinder and the outer edge of the 1⅜ inches diameter caulked.

8th. The caps for the crank shaft bearings are made of cast iron, finished on top and bottom, drilled for two ¼ of an inch tap bolts which screw into the main frame.

9th. The steam ports are 3-16 by ¾ of an inch. The exhaust port is ¼ by ¾ of an inch. The metal between the ports is 3-16 of an inch. The valve seat is 1⅝ inches long by 1¼ inches high. The exhaust passage is tapped to receive a half inch pipe. The cylinder has six ¼ of an inch tapped holes for fastening the steam chest. Their positions will be given next month. The end cylinder head is fastened to the cylinder by five ¼ of an inch tap screws, as shown in the end view, don't drill and tap until the head is made. It will be shown next month.

The thickness of all metal is ¼ of an inch, unless otherwise indicated. The engraving is one-fourth actual size. You can measure any part of the engraving which will, when multiplied by four, equal the measure on your drawing. All important dimensions are given, where no dimensions are given make the part by measuring the engraving as above. All finished parts are marked F on the drawing unless mentioned in the printed instructions, or F A O which means finish all over.

\+ + +

Economical Generation of Steam

One of the principal problems yet remaining unsolved in connection with the economical generation of steam, is that of the use of condensed steam, as feed for boilers without the injurious effects of the oil carried over from the lubrication of the engine in which the steam was used. There is a manifest economy in the condensation of steam, and much of the advantage gained by multiple expansion would be lost if the expansion could not be carried below the pressure of the atmosphere. Surface condensers are undoubtedly the best means of accomplishing this end, and the condensed steam makes an admirable feed water for the boiler, except when it contains such a quantity of oil as to cause deposits of non-conducting material upon furnace flues and fire-box sheets. Even a thin film of grease upon the plates of a boiler furnace will keep the water out of contact with the metal, and many furnaces, both corrugated and plain, have gone down from this cause.

The extending use of sight feed lubricators and the feeding of the oil into the steam are well known, and if we remember that all the lubricant which goes into the steam inlet must also go with the exhaust into the condenser, and so back into the boiler, we must take into account the effect which this quantity of grease will have upon the boiler furnace plates, which are so dependent upon the protection of the water to prevent overheating. When there is lime in the feed water the presence of oil in the boiler is especially objectionable, as a soft, spongy, mass is formed, which collects upon crown sheets and flues, often with the most disastrous results.

There are two points in this matter, which, if observed, would enable much of the trouble to be avoided, and that, too, without involving recourse to any special appliances. In most instances far too much oil is fed into the steam, and the engines would work all right with very much less oil than is usually fed to the cylinders. A good quality of oil should be used, but the quantity fed should be made a minimum, not only for economy in the first cost, but also for protection to the boilers. In nearly every case a most wasteful excess of oil exists, and there is loss to one end from excessive oil bills, and at the other end from damaged boilers. In one well known instance a careful engineer was using eight drops of oil to one revolution of the engines, and it was found that this could safely be reduced to one drop to eight revolutions without injury to the cylinders from insufficient lubrication.

Another point is to be noted in regard to the character of the lubricant. The high grade cylinder oils are supposed to be made from mineral sources and to contain no animal matter. The principal difficulty occurs with the small percentage of animal oil, which in order to improve the lubricating qualities is often mixed with cylinder oils. Animal oils should never be permitted to enter the boiler, and the lubricant used in condensing engines should be carefully examined and the absence of animal oil assured.—*Ex.*

Feed-Water Devices

By J. B. Barnes

The subject of feeding water to a boiler has long been a field for experiment, and there are as many ideas upon this subject as there are days in a year, almost every engineer having a pet plan of his own. During my experience as an engineer I have taken note of different devices for the purpose of feeding the water, with an

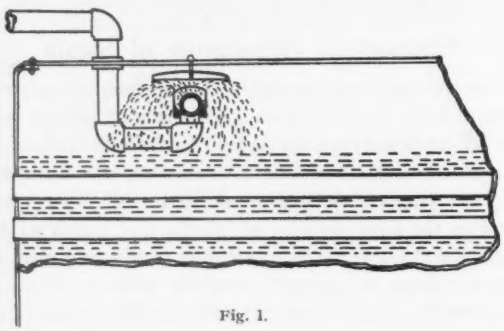


Fig. 1.

idea of obtaining good results,and will herewith endeavor to portray the points of value of a few of them to the readers of "The Practical Engineer."

As will be noticed, I have given preference to those methods which may tend to collect the scale precipitated before it reaches the boiler shell or tubes.

Feeding into the steam-room of a boiler is now quite common. Moore's device, shown in Fig. 1, has been in use some twenty years. The water is admitted, as shown by the overhead pipe and direction of the arrow, through the shell of the boiler into a return fitting, discharging upward at the ball check-valve. A guard over the top of the check-valve prevents any spray touching the overhead shell of the boiler. The feed-water, falling upon the water underneath, is immediately taken up by the circulation without coming in contact with any portion of the boiler.

A suspended pan in the steam-room, with the feed-pipe leading directly into it, as shown in Fig. 2, has been used in a number of boilers by the writer during the past twenty years with good results. The pan may be 3 or 4 feet long, 12 to 18 inches wide, and 3 to 5 inches

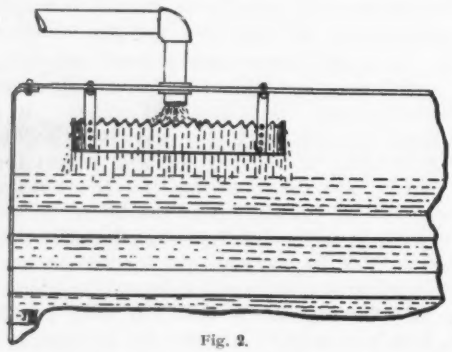


Fig. 2.

deep, according to the size of the boiler. The top edge is serrated like a saw, so that the overflow will occur by drops and not in a stream, the drops being taken up by the circulation proceeding along the surface of the water.

Feeding into an inverted frustrum of a cone, which

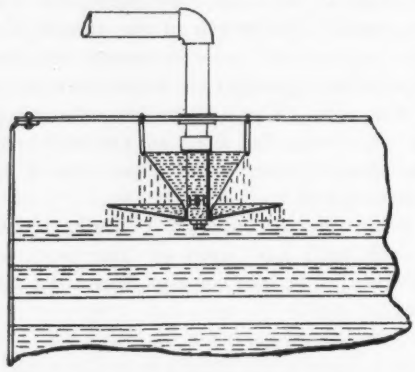


Fig. 3.

overflows into a shallow pan, and from the latter into the boiler, as developed in Ford's device, is shown in Fig. 3. This device, wherever used, has given satisfaction.

A purifying-chamber in the rear end of the water and steam-drums of the water-tube boilers, made by the Standard Boiler Company, is unique in providing an apartment over which the pans are suspended in the

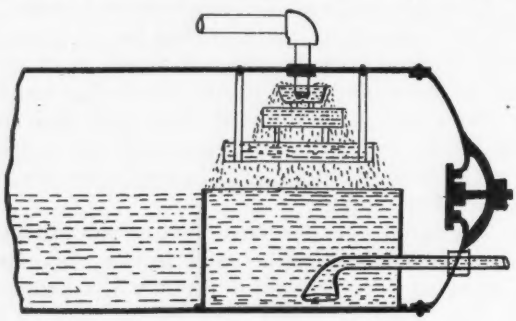


Fig. 4.

steam-space, the overflow of which is not taken up directly by the circulation, but falls into a chamber partitioned off, so as to be uninfluenced by the circulation, as shown in Fig. 4. This purifying-chamber permits a precipitation of the scale-bearing matter into a separate compartment, where it can be discharged through a bottom-blow, also shown in the engraving. By this means the purifying-chamber can be completely emptied, if so desired, without disturbing the water-level in the boiler, a great advantage in any locality where the feed-water contains salts of lime and magnesia.

✣

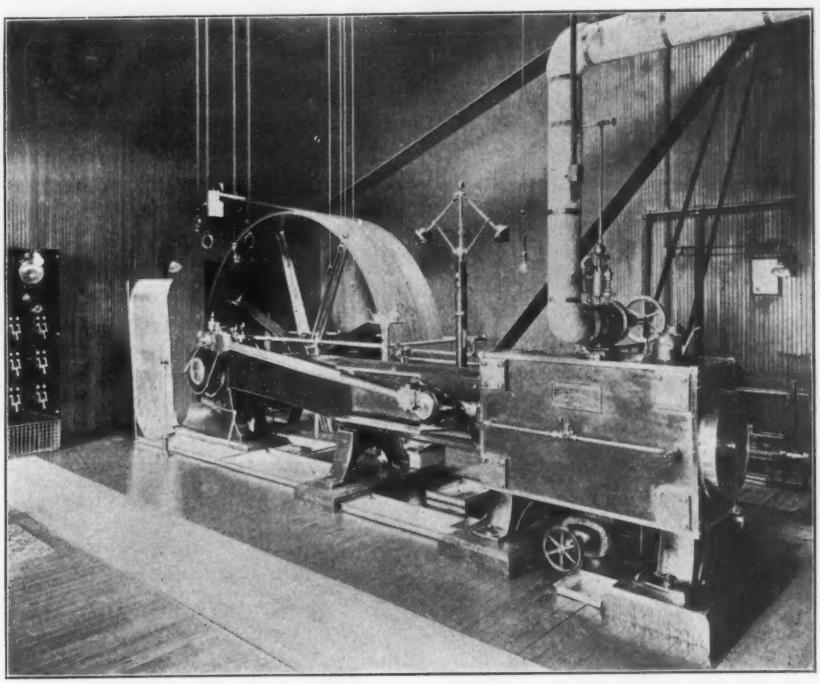
It is stated from Baltimore, Md., that a tremendous enterprise is contemplated by the Gould-Wabash system on the line of the West Virginia Central. Plans have been drawn by which it is expected to lift whole trains loaded with coal or merchandise up the side of a precipitous slope of the Great Backbone Mountains, in Tucker County, W. Va., by means of electric power, and by that method make a double-track road, with an easy down grade both ways. The plan, which is said to have been thoroughly worked out by the engineering corps of the railroad, is a most remarkable one in many ways.

An Ideal Engine Room

To many engineers the work performed, in following their trade or profession, becomes a pleasure which they probably would not dispense with for a goodly sum of money. To others the work is a kind of slavery, and as much as possible of it is correspondingly shunned and neglected. To the most casual observer of an engine room will appear a very fair conception of the man in charge thereof. In many cases a man of careful propensities is not appreciated by his employers in a proper way, yet, invariably such a man will finally become known and appreciated by others.

There are many instances where the co-operation of the employer cannot be secured in the way of providing adequate material &c. Despite this, however, there are many ways whereby the engineer can improve the surroundings of his plant.

In the following description of the engine room of Thomas Halton & Sons, curtain manufacturers, C Street and Allegheny Avenue, Philadelphia, we give an idea of an ideal engine room.



A TIDY ENGINE ROOM.

In the work of maintaining these conditions the engineer has the hearty assistance of the firm. However, there is little here beyond what any other plant of like nature possesses. The general appearance of neatness being due largely to the engineer's love for his work and his ability to properly perform it. Upon the threshold of the engine room door the visitor will find a foot mat, and a glance at the interior will show that it is not there to use coming out. The first glimpse inside shows an array of brightly polished brass and gleaming zinc oil guards, then a well oiled floor with here and there a rug or strip of matting, the whole going to make up a very inviting appearance.

The accompanying illustration shows the engine which is of the Corliss type 16″ by 38″, making 65 revolutions per minute and developing 125 horse-power at full load.

In another corner is a 200 ampere belted dynamo making 700 revolutions. At either end of the room are two polished slate boards, one for the electrical instruments and the other for damper regulator, steam gauge, clock, &c. In the corner back of the engine is a Warren Webster feed-water heater, in connection with the Webster vacuum heating system, with which the entire building is heated.

The boiler feeding is accomplished by means of a triple belt pump and a Smith-Vaile duplex pump 4″x6′ x4″, A feature very noticeable is the smooth running of the above named appliances—not a knock or a thump to be heard.

From the engine room proper we descend well kept stairs with polished hand rail into a separate room containing a high duty fire pump 16″ by 9″ by 12″, built by the Barr Pumping Engine Co., Philadelphia. This pump maintains a hose pressure of 110 pounds per square inch discharging through three 1⅛″ nozzles. The value of this pump was recently established through a fire breaking out in the building, which, despite considerable headway gained, was extinguished before the city department could respond to a call.

From here we go on to the boiler room and are met with the same view of extreme cleanliness; the boiler is of the regular horizontal fire tube type 18″ by 66″, steam drum 12″ by 30″, 36 five inch tubes. The rated horse-power is 100 at a pressure of 125 pounds per square inch. A noticeable appliance attached to the boiler is the Lamprey Protective Circulating Furnace Arch—the engineer, James Morrow, claims that it adds 1½ horse-power per hour to the boiler. Directly in front of the boiler is a chute from a coal bin of 75 tons storage capacity.

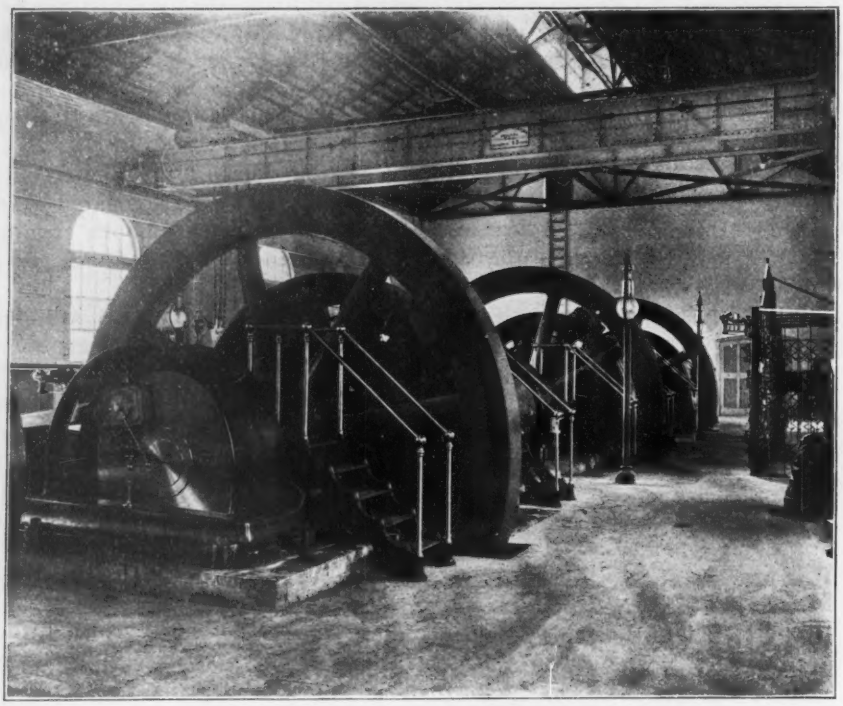
To the mind of the layman there must appear to be considerable work in maintaining the plant in its present condition, yet the entire operation is conducted by one man, and, while he is kept at work to do so, he is not rushed by any means—the secret of success being in keeping up with the work after you have it in hand. The principal expense being that of judiciously expended labor.

✦

Don't "brother" every engineer that you see, he may think that you have an axe to grind and may object to your bringing it to a razor-edge on him. Plain Tom, Dick and Harry should be good enough for any brotherhood man.

An Electric Cement-Making Plant

An electric power plant recently installed at the Alsen American Portland Cement Works, at Alsen, seven miles below Catskill, Green County, New York, furnishes an excellent example of the adaptability of electric power to meet the severe requirements of cement-making machinery. This is the only cement manufacturing plant in America using electrical power so extensively and exclusively. The extended area on which power is required to be distributed, and the heavy overloads under which many of the machines start, constitute the greatest problem in driving machinery in cement mills. These conditions appear to have been successfully met in this installation.

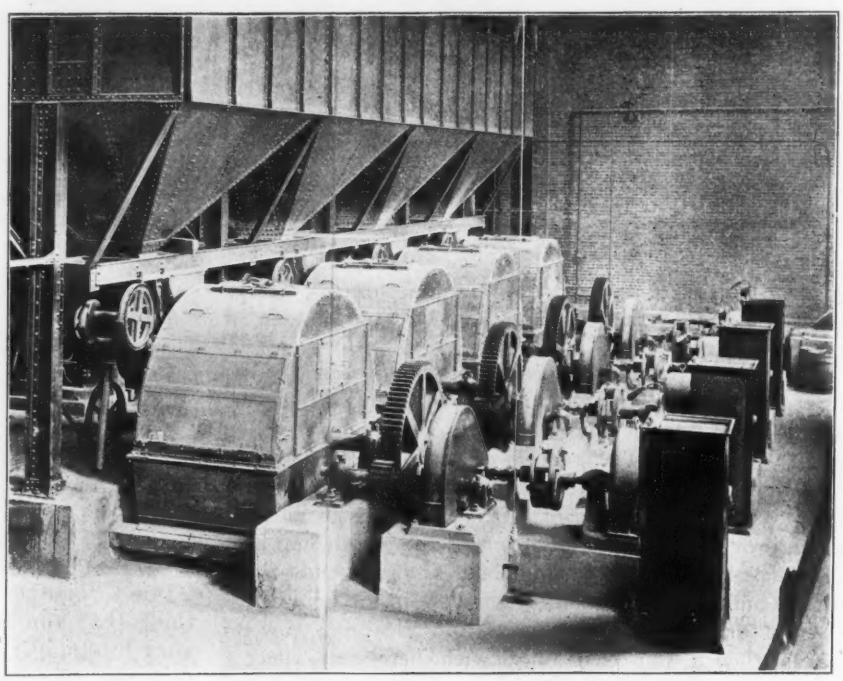


ENGINE-ROOM, SHOWING SWITCHBOARD AND EQUALIZERS.

The boiler plant consists of four horizontal water-tube boilers, of 300-hp each, working at 150 lbs. pressure. Natural draft is furnished by a chimney 210 feet in height. The generating plant consists of three cross-compound Corliss-type engines, each direct-connected to a 400-kw generator, running at 90 r. p. m. The fly-wheel and generator are placed between the frames of the high and low-pressure cylinders. There is also one automatic tandem-compound engine direct-connected to a 100-kw generator, running at 200 r. p. m. The generators are wound for direct current and 250 volts. A 15-ton crane spans the width of the generator room, and travels the entire length. The room is lighted with arc lamps mounted on ornamental cast-iron posts.

The switch-board is of colored marble, and contains four generator panels, one total load panel, four power panels and one lighting panel. The board is equipped with circuit breakers, illuminated-dial instruments and a recording wattmeter of 5,000-ampere capacity. The service switches are all fused on the back of the board, and the distributing switches are provided with illuminated name-plates, which are placed in front of an opening cut through the marble; back of this is connected a lamp, which serves as a pilot lamp for that circuit and illumination for the name-plate. Connections are made between dynamos and switch-board by lead-covered cables carried under the floor of the engine room, excavations around the foundations and under the entire engine room floor providing ample space for the arrangement of cables and connections.

All power generated is electrical, a total of 2,500-hp being developed. Current is supplied to 51 motors and for lighting service. The system of electrical distribution is by means



VIEW OF BALL MILLS, SHOWING MOTORS, FLEXIBLE COUPLINGS AND GEARING.

of underground ducts and cables, manholes being constructed at convenient points throughout the mills, and separate feeders run to each group of motors. The cables generally are of a standard size, 500,000-cm. cross-section.

Motors installed throughout the plant are of the slow-speed type, and are designed and wound for the particular service required of them, individual motors being generally direct-coupled or direct-geared with flexible coupling. Gears are provided with planished iron, dust-proof covers, the arrangement of the covers being such that the gears can be readily inspected; the lower section of the gear case is a heavy casting set in the foundation construction, which permits of the gears being run in oil.

Each motor is provided with a starting panel mounted on an angle-iron construction, erected on a heavy cast-iron base and enclosed with a planished iron cabinet. Each cabinet is divided into three sections. The first or lower section is designed for the starting resistance, which is unusually heavy, to allow for the severe overloads required to start the various machinery; the second section is designed for the multiple switches for cutting out the resistance; the third section is designed for the circuit breaker, knife switch and fuse. Circuit breakers are provided with a stop device, arranged to prevent action when the motors are thrown in, thus providing a time-element feature. Above the third section, at the top of the cabinet, is mounted, exposed to view, an ammeter and pilot lamp; the ammeter is continuously in circuit, showing at all times the load on the motors.

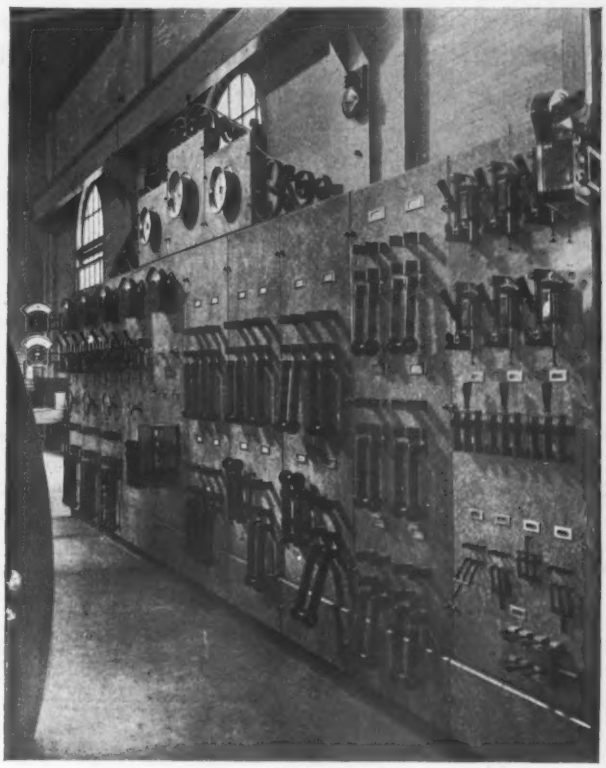
Cement-dust collectors are electrically operated. Two collectors are installed, one in the raw material department, and one in the finished material department, connection being made from the collector direct to the various machines.

The pumping station is located on the Hudson River, about one mile from the power-house, and is connected by a pole line. The motor pump supplies water to a reservoir for boiler feed, condensing purposes and general use.

The quarry is located about a half mile from the main building, connected by a tram road. Electric drills are used throughout, power being secured from the main generating plant by a pole line connection. At the quarry, a direct-current motor drives an alternating-current generator of low voltage and low frequency, from which the drills are operated. The drills are each provided with double solenoids, which are alternately energized, drawing the drill spindle up and down through the coil. A rotary motion is given to the spindle by means of a rifled rod, ratchet and pawl.

The lightning is installed on the 110-volt, three-wire system, with a duplicate set motor-generator equalizers installed in the engine room. These equalizers consist of two 5-hp direct-current, shunt-wound motors, connected in pairs on a common bed plate by flexible couplings. The equalizers are thrown in circuit by means of a triple-break, two-pole switch, resistance being inserted through the different clips of the switch. A double-reading ammeter shows the amount of current furnished to either side of the system.

The buildings are lighted by incandescent electric clusters, which are hung below the bottom chord of the roof trusses, and are provided with lowering apparatus similar to that generally used for arc lamps. The various machines and tunnels are lighted with single incandescent lights. The wiring throughout the buildings is installed in steel conduit.



ENGINE-ROOM SWITCHBOARD.

The grounds around the buildings are lighted by arc lamps suspended from iron brackets bolted to the walls of the buildings. The centers of distribution for lighting service are placed at various locations throughout the mills, and are fitted with planished iron cabinets of general design and construction similar to those described for motors. Each lighting circuit is controlled by a separate switch.

A signal system is provided from various locations throughout the mills, connecting with a signal gong in the engine room for the purpose of signalling to the engine room for cutting in or out current to various feeders.

A fire-signal system is installed throughout the entire plant, connecting the various points with an alarm in the chief engineer's office. A complete private telephone system affords connection between various points throughout the plant, the offices of the company and the private dwellings of the officers. The complete plant was installed by the D'Olier Engineering Company.

Don't neglect to keep loafers far, far away.

The Practical Engineer.

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L. L RICE, Proprietor, 1213-15 Filbert Street, Philadelphia, Pa

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AMERICAN ORDER STEAM ENGINEERS — NEWS OF THE COUNCILS

Brother Harry Sherman has resigned his position at the High School, Wilmington, Del., to accept a better offer at Bancrofts Mills.

✣

Brother B. F. Myrick formerly of Grants Pass, Oregon, has been admitted into Southwark Council, Philadelphia. Mr. Myrick was the organizer of Oregon Council, No. 1. Becoming acquainted by correspondence with the editor of this journal and officers of the A. O. S. E., he eventually decided to migrate east, and coming to Philadelphia he found such a warm welcome from the boys with several offers of good positions that he brought his family on, and has now located permanently in this city.

✣

Iron City Council, No. 21, of Pittsburg, held another smoker on Saturday evening, December 13 which like the previous one held some weeks ago was a decided success. During a short business session preceding nominations for officers were made and admiral candidates for each office secured. There was also a general discussion of ways and means of entertaining the officers and delegates to the next convention of the Supreme Council to be held at Pittsburg the week of May 11, 1903.

Mr. L. L. Rice of this journal was agreeably entertained at the Duquesne hotel, Pittsburg on the evening of December 1 by a party of members of Iron City Council including L. F. Vandergrift, P. J. O'Sullivan, A. D. Hamilton and others.

✣

Germantown Council, No. 22, Philadelphia, will hold another of their delightful open meetings and entertainments at an early date.

✣ ✣ ✣

Oyster Roast at Baltimore

Baltimore has been famed for oysters ever since the oyster had a shell on his back. It should be no less famed for the hospitality of its engineers, for the fellow who thinks that Baltimore engineers are clams is likely to be put down as a lobster. He at least will be by those who attended the Oyster Roast given by Maryland and Energy Councils to their members and friends on Sunday, November 30, for it was a jolly day despite continuous rain.

In addition to about a hundred Baltimoreans there were present a score or more of visitors from Philadelphia, Atlantic City and Wilmington, Del. Special trolley cars were chartered and given the right of way to the end of the line some twelve miles below the city after which the party was transported some two miles farther down into the woods to an ideal spot where the committee was in waiting with some thirty barrels of oysters and a retinue of colored cooks and firemen. Oysters were stewed, fried, panned, scalloped and served raw, while two large roasting irons were kept going all day. Each person was presented with a new oyster knife, and the boys crowded around the fires enjoying a mixture of smoke, rain and roasted oysters—the most delicious morsel imaginable.

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A Pleasant Evening with Southwark Council

On Wednesday night, December 3rd, Southwark Council A. O. S. E., gave a reception to their members and friends which will be remembered with pleasure by all who were present. Indeed, the affair so far surpassed, in every way, anything heretofore attempted by this Council that it has awakened a renewed feeling of interest which promises many new acquisitions to the ranks of the Order. Invitations were extended to all members of the Order, with the result that there was present a number of members from Baltimore, Wilmington, Chester, Reading and Atlantic City, with each Philadelphia Council well represented, all saying that too much praise could not be given the committee for the excellent entertainment furnished.

The Council rooms of Southwark Council being inadequate in size for the occasion, the banquet hall in the auditorium of the Odd Fellows' Temple was secured. Here the visitor was met at the doors by a special committee, and, after being divested of hat and overcoat, was escorted to the hall proper, where, with the

services of a competent caterer a bountiful supper, replete with the garnishings that make merry was furnished to over three hundred persons.

In addition to the supper a unique entertainment was given those present by a vaudeville troupe which was most successful in elicting applause for the clever manner in which the members rendered their respective parts. Mr. George McKinney furnished excellent piano music and delightfully rendered "The Star Spangled Banner" on the organ. Helen Jackson and Maud Douglass sang songs and danced charmingly; Ben Reinhold impersonated "Our Hebrew Friend" to perfection and Tony Baker made a good black faced comedian. There were humorous stories, lots of good jokes and Margurite Clemens sang several popular songs of the day. It was a nice affair throughout.

* * *

Educational Committee, A. O. S. E.

JOHN MARTIN, Secretary, 2655 East Clearfield St., Phila.

The following questions are intended to create discussion in councils of the American Order of Steam Engineers. Answers will not be required by the Committee but prizes will be awarded by the Committee for the best essays prepared by individual members upon any of the questions asked. The PRACTICAL ENGINEER will give cash prizes for the best essays prepared by engineers whether members of the A. O. S. E. or not.

1. At what point does the greatest evaporation take place in a return tubular boiler?

2. What effect would an increased circulation in such boiler have upon its efficiency?

3. Is it possible to apply a device externally to increase circulation?

4. Would the application of such a device be a paying investment?

5. What essential requirements should such a device possess?

* * *

The Value of Steam Jackets

It is yet something of an open question as to just how much benefit is derived from the use of steam jackets. Theoretically the benefit would appear to be small, especially when used in connection with high piston speed, but it is a fact that in practice the use of the steam jacket, even with high piston speed, shows a gain in economy that returns a good interest upon the investment. In pumping engines and other engines running at slow speeds this gain is marked. As the piston speed increases the ratio of gain becomes less. It would seem that the main benefit is derived from keeping the walls of the cylinder more nearly of a uniform temperature. Whatever of heat is imparted to the contents of the cylinder during the return stroke when the exhaust valve is open is wasted. The raising of the temperature of the walls of the cylinder to more nearly approach to the temperature of the entering steam is where the gain lies, and as it is estimated that the loss by initial condensation in unjacketed engines amounts to twenty-five to fifty per cent. it will be seen that any reduction in the initial condensation must effect a saving in the amount of steam used. From data derived from practical tests the degree of saving effected by the use of steam jackets ranges from five to fifteen per cent. In the best class of engines the steam jacket will continue to be used until such time as means are found to line steam cylinders with non-conducting material, of which there is no immediate probability. There is one thing about steam jackets which engineers frequently overlook. To be of any value they must be operative, and be supplied with steam of at least as high temperature as the initial temperature of the steam in the cylinder. If the jackets are allowed to fill with water, or are so constructed as to prevent free circulation of steam and rapid drainage of the condensed water these are more than useless.

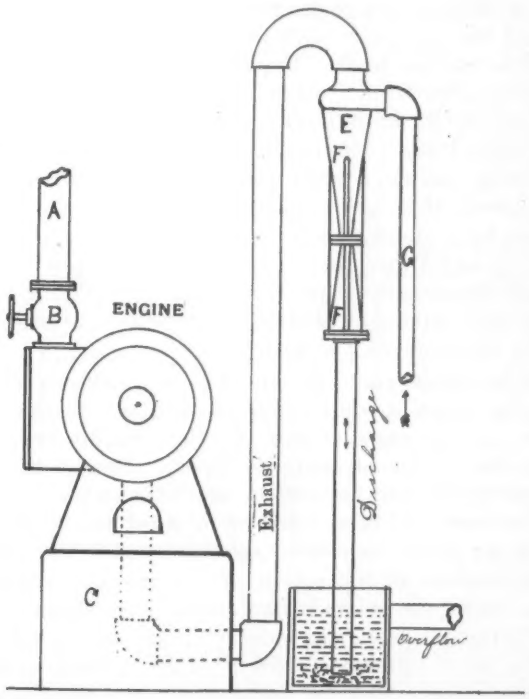
* * *

The Injector Condenser

A siphon, or injector condenser, as it is more often called is simply a method of using the exhaust steam in a manner similar to that of the Ciffard boiler feed injector, excepting that the water is not forced into the boiler and is used merely to condense the exhaust steam.

The object of a condenser when applied to engines or pumps is to remove from the exhaust side of the piston the pressure of the atmosphere. This then represents a gain of power, or a corresponding steam or fuel economy.

The pressure is removed by exhausting into a vacuum instead of against the atmosphere.



The vacuum is created and maintained by a moving column of water, which condenses the exhaust steam, and at the same time expels uncondensable air contained in the steam.

The flow and required speed of the columns is produced either by pressure, or by induction of the current,

through impact of the exhaust in the direction of the flow.

The reason why the exhaust steam can be used as the propelling force of the water, without causing a back pressure, and thereby defeat the purpose, is as follows:

The greater volume of the exhaust is discharged when the engine is on the dead center, and the propulsive work on the water column is done during that time, while during the stroke, when the work of the engine is done, the smaller volume of the remaining exhaust finds a column of cold water in full speed.

The apparatus consists of two cone shaped nozzles, joined by a straight neck, and swelled at the upper end for the junction of the water-nozzle. Within is the exhaust-steam nozzle, which forms within the condenser a narrow, annular space for the entrance of the condensing water. The sides of the condenser (which are paraboloidal curves) are smoothly finished, as is the contracted neck below, to diminish the resistance of the water. When used in connection with a condensing engine, the air-pump may be dispensed with, as steam of atmospheric pressure will flow into a vacuum at the rate of 1600 feet per second.

When the exhaust steam from the engine meets the thin film of water which enters the annular space, it is instantly condensed. As the water passes down, the contracting outline of the condenser gradually brings it to a solid jet in the neck below, through which it rushes with a velocity due to its pressure. The air which has entered the condenser with the water, or through leaky joints or stuffing-boxes, together with the uncondensed vapor, is thus drawn down into a contracting, hollow cone of water, until finally expelled through the neck. This latter being straight for a distance, is virtually the air-pump, having a solid piston of water moving at a high speed; thus is the steam condensed, and the vacuum formed by a single process, and with greater certainty than in any other way. The air and vapor having passed the contracted neck, entering the tapering nozzle below, and expanding therein are prevented from returning to the condenser above.

The accompanying cut represents a condenser of this type, in which A shows the steam-pipe; B, the stop-valve; C, the exhaust-pipe; E, the annular head into which the condensing-water is thrown through the pipe, G, and by the arrangement of which the water is formed into a sheet; FF shows the two inverted nozzles through which the condensing-water escapes into the hot well, H.

The method of operation of the injector condenser when the engine starts is as follows: the exhaust steam expels the air from the exhaust pipe and condenser; then a jet of cold water from a pump or tank creates a vacuum, which may be maintained by a head of water of 10 feet fall. The discharge water passes off at a temperature of 110° to 112°, when the vacuum is equal to 26 inches of mercury.

The advantages of the injector condenser are, that it is simple and durable; that the injection-water is self-regulating; that there is no possibility of the water being carried over into the cylinder; that by the removal of a bonnet, the exhaust steam may be allowed to escape into the atmosphere, thus converting the engine from high to low pressure; that the condenser requires no foundation or other attachment save an ordinary pump to raise the water when there is not sufficient fall; and that the condenser can be attached to any engine in any locality where the necessary supply of water can be obtained, which ranges from 22 to 25 times as much as that from which the steam would be generated.

\+ + +

The Production and Properties of Calcium Carbide

By T. H. Reardon

The manufacture of Calcium carbide is intimately connected with the utilization of the electrical energy generated by water power at Niagara Falls, N. Y. As the electrical method of production is the only one that is commercially possible, and as the energy required to produce a pound of carbide is relatively large, about 2.5 E. H. P. hours measured at the furnace terminals per lb. produced it follows that this article cannot be produced in a commercial way unless electrical energy is available in an enormous amount and at an extremely low cost.

Calcium carbide consists of calcium and carbon, in the proportion by weight calcium 40 and carbon 24. In the process of its manufacture coke and quick-lime both finely pulverized and intimately mixed, are placed in the electrical furnace, which is arranged on the arc principle, and the heat that is necessary to fuse this mixture is reached and maintained for several hours. The accurate estimation of the temperature that exists in the interior of the electric furnace is a very difficult matter, but the best authorities give it as 4500 deg. F.

The fusing point of platinum is usually given as 3227 deg. F., and this will enable one to form a fairly accurate estimate of the temperature in the electric furnace.

The proportion of lime and coke placed in the furnace is as follows: lime 56, coke 36; the products formed are calcium carbide 64, carbon monoxide 28, the latter passing off and escaping.

A very interesting matter, and one that should not escape notice in this reaction, is the extreme difficulty experienced in the attempt to isolate the metal calcium and obtain it in the metallic state; it is obtained in the metallic condition, however, by an electrolytic (wet) process, and when so obtained it commands the very modest price of $.80 per oz.

Calcium carbide, the source of acetylene gas is a dark colored extremely hard substance; it is very stable, heat and many chemical reagents having no effect on it; it reacts instantly with water double decomposition occurring, the carbon of the carbide and hydrogen of the water uniting to form acetylene $C_2 H_2$ while the calcium of the carbide and the oxygen of the water unite to form calcium hydrate or slaked lime Ca (OH_2) the following formula expresses the reaction that takes place:

Calcium carbide + water = Calcium hydrate + acetylene

$CaC_2 + 2(H_2O) = Ca(OH)_2 + C_2H_2$

$64 + 36 = 74 + 26$

The equation expresses the reaction for chemically pure carbide and shows that for 64 parts of carbide 26 parts of acetylene are produced, the proportion of both substances being by weight. One pound of carbide on the above basis yields 6½ ounces of acetylene gas which has a volume of very nearly 5.9 cubic feet. As commercial calcium carbide is not chemically pure, this yield of acetylene will not be obtained in practice, usually about 5 cubic feet per lb. is what is obtained.

The 5 cubic feet of acetylene will give about 250 candle power hours of illumination while the electrical energy required for the production of the pound of carbide from which it is derived would give with incandescent lamps of 3.5 watts per candle efficiency about 533 candle power hours of illumination, from this it follows that the efficiency at the point at which the illumination is produced is only about 46.9 per cent., in other words if 46.9 per cent. of the electrical energy used in producing the carbide, could be delivered at the point of consumption, acetylene would possess no advantage over the electrical energy from which it is derived as an illuminating agent.

The illumination produced by acetylene gas, is without any doubt of a very superior quality and, while it has received several set backs, owing to the fact that it has of necessity been placed in the hands of those that do not possess the minimum of intelligence required for its reproduction and use, it is after all the ideal illuminant for isolated districts, both in point of cost and in the character of the light produced.

Only one instance of the use of acetylene for heating has come under the writer's observation, that is its use for brazing in one establishment in town, it is giving perfect satisfaction.

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QUESTIONS AND ANSWERS.

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers with questions, he especially desires the readers in such cases to contribute any further information in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communications.

Editor PRACTICAL ENGINEER:

How can I find the amount of coal consumed in drying out a pound of water from paper web passing over machine driers heated with the steam?

For example, suppose for every ton of dried paper there is an additional two tons of water contained therein before passing over the rolls. These rolls are iron cylinders 20 in number, 4 feet in diameter, the paper passing over them all during the drying process which requires one hour—the pressure of steam in the rolls being kept at 40 pounds per square inch.

PAPER MAKER.

Your answer can only be ascertained by direct experiment. The drying process is by radiation of heat from the rolls, now it requires so many heat units to evaporate two tons of water in one hour, but there is no rule by which it is possible to tell the amount of units radiated which pass into the surrounding atmosphere, and in no way assisting in the drying process. Hence, we cannot say how many units of heat are thus lost. If we knew the size of the roller-thickness of shell, length of roll, &c., we might in that way tell the amount of heat escaping from the entire surface of the twenty rolls. This loss per hour divided by the number of heat units raised from one pound of coal will give an approximate result. But, as before stated, the only means of obtaining accurate data on the subject is by direct experiment.—Editor.

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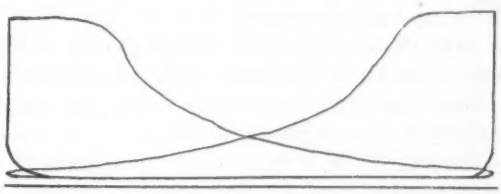
Editor PRACTICAL ENGINEER:

I am a new beginner in the matter of reading your journal, and take the liberty of writing you for information upon the enclosed indicator card. It is taken from a Filer & Stowell Corliss engine 14" by 36", boiler



pressure 100 pounds, revolutions 100, indicator spring 60. I would like you to figure it out and give me the indicated horse-power. I would also like to have criticisms from other readers of the PRACTICAL ENGINEER.

Detroit, Mich. CHAS. BOYER.

✦

The indicated horse-power is found by multiplying together the piston area, the mean effective pressure and the travel of the piston in feet per minute, and dividing the product by 33,000. Hence your card indicates as follows: M. E. P. 32 lbs.x600 feet (the piston travels per minute) x 153.93" (area of piston) divided by 33,000 lbs.=89.55 I. H. P.—Editor.

✦ ✦ ✦

Dear Sir: Please inform me in your next issue how to find the specific gravity of any solid, and also how to find its weight per cubic foot when the specific gravity is known? CHAS. C. WRIGHT.

✦

The specific gravity of a body is the ratio of its weight to the weight of an equal volume of some other body assumed as a conventional standard. The standard usually adopted for solids and liquids is rain or distilled water at a common temperature. In bodies of equal magnitudes the specific gravities are directly as their weights or as their densities. In bodies of the same specific gravity their weights will be as the magnitudes. In bodies of the equal weights the specific grav-

ities are inversely as the magnitudes. The weights of different bodies are to each other in the compound ratio of their magnitudes and specific gravities. Hence, it is obvious that, speaking of the magnitude, weight and specific gravity of a body, if any two of them are given, the third may be found. A body, immersed in a fluid, will sink if its specific gravity be greater than that of the fluid; if it be less, the body will rise to the top and be only partly immersed, and if the specific gravity of the body and fluid be equal, it will remain at rest in any part of the fluid in which it may be placed. When a body is heavier than a fluid, it loses as much of its weight when immersed as is equal to a quantity of the fluid of the same bulk or magnitude. If the specific gravity of the fluid be greater than that of the body, then the quantity of fluid displaced by the part immersed is equal to the weight of the whole body. The specific gravities of equal solids are as their parts immersed in the same fluid.

If it is heavier than water, weigh it in air, and then weigh it suspended in water. The difference in weight is the weight of an equal bulk of water. Divide the weight in air by the weight of the equal bulk of water and the quotient is the specific gravity.

If the body floats, put just the weight on it that is necessary to make it sink even with the surface of the water. Then from the sum of this weight and the weight in air subtract the weight in water.

The difference is the weight of an equal bulk of water. Divide the weight in air by this and the quotient will be the specific gravity.

EXAMPLES.

Since the gases are so much lighter than water, it is usual to take the specific gravity of a gas as the ratio between the weight of a certain volume of the gas and the weight of the same volume of air.

Example.—A cubic foot of cast iron weighs 450 pounds; what is its specific gravity, a cubic foot of water weighing 62.5 pounds?

Solution.— $\frac{450}{6.25}=7.2$ Ans.

The specific gravities of different bodies are given in printed tables; hence, if it is desired to know the weight of a body that can not be conveniently weighed, calculate its cubical contents. Multiply the specific gravity of the body by the weight of a like volume of water, remembering that a cubic foot of water weighs 62.5 pounds.

Example.—How much will 3,214 cubic inches of cast iron weigh? Take its specific gravity as 7.21.

Solution.—Since 1 cubic foot of water weighs 62.5 pounds, 3,214 cubic inches weigh

$\frac{3,214}{1,728} \times 62.5=116.25$ pounds.

$116.25 \times 1.72=838.16$ pounds. Ans.

Editor.

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Editor PRACTICAL ENGINEER:

I am a reader of your valuable magazine, and, being unfamiliar with the automatic cut-off, ask you to reply to the following questions:

Does one need an indicator to set the valves or are they set the same as a common slide valve on a throttling engine?

Is an automatic engine higher speeded than a throttling engine of the same horse-power?

Does one need any former experience to indicate an engine?

✣

1st. To correctly set the valves of an engine the use of the indicator is necessary, although good results are often obtained without its use, in cases of either type of an engine.

2nd. The same speed, pressure and cylinder ratio would result in equal horse-power in either case. Throttling engines are usually higher speeded for the same horse-power than are engines of the automatic valve gear type.

3rd. To indicate an engine requires some experience yes; but, to correctly read the cards requires a pretty thorough knowledge of the subject. However, the novice may experiment with an indicator without danger of mishaps if he be careful and in that way gain experience.—Editor.

✣ ✣ ✣

Editor PRACTICAL ENGINEER:

Will you in your next issue please explain the construction of a "Siphon" condenser?

I understand the "jet" and the "Surface" but have never seen a "Siphon," and the books I have do not explain it so I quite understand it.

Thanking you in advance for the favor.

I am very truly yours,

A. L. PALMER,
Ithaca, N. Y.

✣

The reader, for answer to the above question, is referred to an article appearing elsewhere in this edition under the caption of "The Injector Condenser".

Editor.

✣ ✣ ✣

Editor PRACTICAL ENGINEER:

I would like to know if the water we catch from our air shaft will injure our boiler. The smoke from the boiler furnace comes up the shaft and causes the water to take on a darkish hue. We catch the water before it reaches the pump. T. C. WRIGHT.

✣

Water, as you probably know, is of a very absorbing nature, and if the coal you are using contains much sulphur, you will find the sulphurous fumes will become amalgamated with the water, creating a sulphuric acid condition, which will be more or less injurious to the boiler metal, according to the amount of sulphur contained in the water.—Editor.

✣ ✣ ✣

Don' forget the waste and use it, and don't scrub the floor if you can possibly get out of it.

LETTERS FROM ENGINEERS

In order to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories and general engine room experiences are especially solicited.

"Boiler Horse-power"

EDITOR PRACTICAL ENGINEER:

In your December issue you publish a contributed article which, in several instances, appears to contradict the statements which I have made regarding the use of the term "boiler horse-power." I have no wish to be drawn into a lengthy controversy upon this topic, but the contradictions which I refer to have, in a measure, put the stamp of unreliability upon my statements. It is neither my desire nor my intention to appear in the light of an irresponsible writer before the readers of your journal, and for that reason I trust you will permit me to make a few additional statements regarding the disputed point.

It is quite true that as early as 1876 there were boilers which carried more than 70 pounds pressure. It is just as indisputable that feed-water heaters existed which could give feed-water temperatures above 100° F., and there were engines which developed a horse-power on less than 30 pounds of water per hour.

But—and this is the point to which my critic has apparently closed both eyes—such performances did *not* represent the average practice of that day. The standard proposed by the Committee of Judges was stated, as it now stands, because the conditions mentioned therein were those of ordinary, fair practice in steam engineering at that time.

If heaters giving 212° F. feed-water temperature were so widely used at the time of the Centennial, then why did the Committee of Judges select 100° F. as the basis? Why should they not have taken 212° F., or some other figure more nearly approaching 212° F.? The answer is so obvious as scarcely to require repetition. The standard was selected to conform to *average* conditions.

We have nowadays many engines which are developing one horse-power per hour on 15 pounds of steam. But that does not represent average practice. We have boilers which evaporate 10 pounds of water per pound of coal, but this is not an average or usual performance. We have feed-water heaters to-day giving a temperature of 212 F., but they are by no means universally used.

The point I wish to make clear is, that I made no distortion of facts, nor any misstatement, when I said that the standard of evaporation capacity was based on average pressures, temperatures and steam consumptions prevailing a quarter of a century ago.

If all men were engineers, and knew what a vast difference exists between the values of one horse-power used in its two senses, there might be less objection to the use of the term as applied to the steam boiler. But, unfortunately, there are many men who have occasion to purchase boilers, whose knowledge of horse-power is limited to a comprehension of the equivalent 33,000 foot-pounds per minute. To them, who are vitally interested, the double meaning of the term applied to objects which always must be closely related, will never cease to result in confusion, and doubtless disgust, also.

I do not pretend to stand alone in holding the views on this subject which I have expressed. That "boiler horse-power" is not just the satisfactory term which some evidently believe it to be, may be gleaned from a few quotations from several well known and authoritative sources.

Thurston, in his "Manual of Steam Boilers," has this to say: "It is evident that since the boiler is merely an apparatus for the generation of steam, and since the province of the steam engine is to develop power from that steam, and with a degree of efficiency which may vary enormously, it is certain that we have no natural unit of power for steam boilers. It may be even asserted that no natural unit can exist."

"It is considered usually advisable to assume a set of practically attainable conditions in average good practice and to take the power so attainable as the measure of the power of the boiler in commercial and engineering transactions. The unit generally assumed has been the weight of steam demanded per horse-power per hour by a fairly good steam engine. This magnitude has been gradually decreasing, from the earliest period of the history of the steam engine."

Kent, in his "Mechanical Engineers' Pocketbook," writes as follows: "The second definition of the term horse-power is an approximate measure of the size, capacity, value, or rating of a boiler, engine, waterwheel or other source or conveyor of energy, by which measure it may be bought and sold, described, advertised, etc. No definite value can be given to this measure, which varies largely with local custom or individual opinion of makers and users of machinery."

In the booklet on "Steam," published by the Babcock & Wilcox Co., the following statements occur: "Strictly speaking, there is no such thing as 'horse-power' to a steam boiler; it is a measure applicable only to dynamic effect. But as boilers are necessary to drive steam engines, the same measure applied to steam engines has come to be universally applied to the boiler, and cannot well be discarded. In consequence however, of the different quantity of steam necessary to produce a horse-power, with different engines, there has been great need of an accepted standard by which the amount of boiler required to provide steam for a commercial horse-power may be determined."

The greatest changes never occur instantaneously. No one expects to see the entire engineering world drop the boiler horse-power to-day and take up a new standard to-morrow. But, in my belief,the change is none the less sure to come,at some time in the not far distant future.

R. T. STROHM.

✦ ✦ ✦

"A Murderous Practice"

Dear Editor:

Your article of the December issue under the above caption, or something in the same tone, should be brought more prominently before the public, especially the shopping public, and those having friends and relatives in institutes of learning, where every minute of their lives they are in danger, owing to the long hours that those in charge have to submit to, or accept the alternative (*i. e.*) quit.

Where I work we have monthly shifts alternating night and day; the night-shift works 91 hours each week and the day-shift 66 hours—and closely confined; not allowed even five minutes for dinner only what we can catch in the engine-room, and on the night-shift it is directly the opposite. We are sent all over the building; even out of the buildings from where the power plant is to do repair work; often not even seeing the engine-room from 12 o'clock at night until 4 or 5 in the morning. The fireman is expected to run in occasionally to see if the engines are still on their foundation. Once it happened that a 40 K. W. dynamo was entirely burnt out, while the engineer was putting washers on some water spigots—in fact was working in another ward; he might as well have been in another state, although it was just across the street, and the consequences of his refusal to do the work would have been sufficient cause for his discharge.

Such an order of things tend to make an engineer careless at other times. Now, if such a state of things could be brought before the public through the daily papers, I believe, with the danger explained, of an engineer being away from his post of duty, conditions would be altered, for I don't think shoppers or parents would appreciate a firm or institute who would allow such practice. If they withdrew their patronage, necessity from the lack of attendance would compel them to change the order to a more rigid business basis.

By giving this space in your paper it might stimulate others to contribute something more worthy of your columns. Yours very truly,

J. B.

✦

If the above writer were a student of social or political economy, or even of human nature, he would know that all reforms result from movements inspired by direct personal interest exerted either individually or collectively by those affected; and in this case the engineer is the one with a grievance. There never was a clearer case of "The public be d—d." The public knows or cares nothing about the matter, and if they did they would doubtless prescribe wrongly. The only way to secure improved conditions for engineers is through the united efforts of the engineers themselves.

✦ ✦ ✦

Grease Versus Oil

Editor The PRACTICAL ENGINEER:

I have been much interested in the discussion, in the engineers' letter column of your journal, upon the subject of "Grease Versus Oil." In sending you this letter, my object is to give the results of my experience with greases of the several kinds now on the market for lubricating machinery.

Experience has taught me to use grease as a lubricant because it reduces friction in the bearings, and with less friction we have less disturbing of the latent heat contained therein.

Taking grease as a refrigerant is so preposterous that a mediocre application of common sense would cause the rejection of such a theory. If grease were a refrigerant it would take up sufficient heat to force its particles asunder and their attractiou of cohesion would be overcome sufficiently to cause it to drop off the bearings instead of spreading over them. As I understand the word refrigerant, the meaning is something to make cool. Now, if a refrigerant is to make cool it must absorb heat. Grease will absorb just so much heat in ratio to the surrounding atmosphere. For instance, suppose I keep a can of grease in my engine room, in a short time it will attain the same temperature as the room, and will not vary unless the room changes in heat conditions.

To the average layman, and engineer, the theory, subtly advanced, that the medical profession use grease as a refrigerant in cases of burns, etc., may seem plausible because everyone knows that grease is used in such cases. But in such cases any medical man will tell you that where a burn occurs the flesh becomes seered to a considerable depth, thus closing the pores of the skin, and in some cases also the blood pores of the flesh. Now, if relief could be had through the application of a refrigerant, why not apply a block of ice? No, the inflammation can only be reduced by opening these pores, thus restoring the natural functions. Science has discovered that the most efficient means of doing this is by lubrication, hence grease is used as a lubricant to soften the flesh in such cases—grease being given the preference because of its combined lubricating and adhesive properties—certainly not as a refrigerant. An actual test in such a case would show the grease at the same temperature as the surrounding flesh five minutes after its application, yet the grease is kept applied until circulation is restored.

No one will dispute me when I say that oil is equally as efficient a lubricator as grease. Nor yet will they dispute me when I say that I can make a hotter, cleaner, safer and much easier handled fire by using alcohol fuel in preference to coal, but what sane man would do such a thing. Thus I come to the use of grease in preference to oil, and in making the comparison I will give you an

example obtained by actual tests upon the crank-pin of my engine. I use about 1½ ounces of good quality grease upon the pin in four weeks. In making the tests shown in the accompanying tables I placed a thermometer as near the crank circule when the engine was in motion as I dared and as soon as I stopped the engine, placing the bulb of the thermometer in the centre of pin and against the face of it. This was reported under different loads with the following result of temperature analysis:

Date.	Time.	Temperature.	Tem. of Crank Pin.
Nov. 11	12 Noon	84	89
" 11	6 P. M.	88	94
" 12	12 Noon	84	87.5
" 12	6 P. M.	88	95.5
" 13	12 Noon	89	97
" 13	6 P. M.	89	97.5

Crank pin keyed once in 18 months. Engine, Corliss. Size 12½" cyl. 36" stroke, 78 rev., 80 lbs. steam pressure. You will notice by the above figures that the highest temperature reached above the temperature of the room as 80° F. and the lowest one half of one degree.

There is no doubt that oil would accomplish the same results (certainly not better), but the cost in good oil would exceed the 1½ ounce of grease ten times over.

I have about 1600 feet of shafting in my plant, and I tried a certain grease for lubricating the bearings and found it a poor substitute for oil, yet in comparing the price of it with oil, I used it as being the cheaper of the two. Sometime after the adoption of the grease I was asked to try another grease (at a much higher price) in competition. This I did, and by actual test reduced my friction load 50 per cent. and, furthermore, it made a better showing than the oil.

I cannot give the name of the grease I use, but I will reiterate, I found a good high grade grease to equal oil of the same quality in the matter of friction reduction.

THOS. O. ORGAN, Chief Engineer,
821 Cherry St., Philadelphia.

+ + +

The Sims Exhaust Head

The up-to-date steam user has learned from experience that it is wise to "try before they buy" most of the necessary accessories to a steam plant. This should be true particularly in the case of exhaust heads, as there are so many leaky, flimsy, galvanized sheet iron affairs upon the market which are so short lived that they soon become worse than none at all. The accompanying cut shows an exhaust head built of substantial light cast-iron, bolted together, making it practically indestructible The manufacturers are willing to give a thirty days trial of the appliance to any one anxious to stop the expensive nuisance, the throwing of condensed water, oil, etc., over the roof and buildings.

The method of operation is as follows: In the lower section of the Head is a deflector, with four or more ports (according to the size of the Head) shown at "A" "A," these ports being on a circle gives centrifugal motion to the steam, throwing it against the ribs "B" where the moisture and grease is intercepted. A part of the exhaust steam passes out at the top of the deflector into a cone shaped deflector with considerable force, as indicated by arrows, drives the water from the ribs into the well below from which it is piped off.

Patented and manufactured by The Sims Co., Erie, Pa.

+ + +

Worth Knowing

Increasing the size of a fly-wheel will not increase the amount of work your engine will do. The function of the fly-wheel is to produce a uniform motion. When the engine is "on the center," practically all the moving force of the engine comes from momentum of the fly-wheel. When the full force of the pressure is upon the piston this force is obliged to overcome the inertia of the fly-wheel. In this way the excessive force moving the engine is decreased and the defective force increased at the proper time by the momentum of the fly-wheel, thus insuring a proper regulation of speed. The capacity of your engine is equal to the product of length of stroke, the area of the piston and the mean effective pressure multiplied by the number of revolutions per minute.

+ + +

Don't get red-headed if the secretary duns you for your dues. There isn't any pleasure in it for him I assure you, he don't get the coin, though he is compelled to touch you for it. The man that won't pay his dues—if working—shouldn't belong to any labor organization.

+ + +

Don't try to show off and "shoot the chutes" when another engineer visits you, but simply pursue the even tenor of your way. There isn't any use in trying to pull the hole up because someone has the glass on you. I remember several times that my hair insisted on standing straight when visiting other engine-rooms, and one of the times the cage would have been in the engine-room all right only the tower was too well built.

TRADE NOTES

A new combination packing for vertical elevator pistons that are packed from the top, is being placed on the market by the Walsh Packing Co., 1118 S. Seventh St., Philadelphia. This new packing consists of metal, duck and specially treated flax rings. It is said to be very durable and to alleviate the friction on the rod. A booklet giving description in detail will be sent to those interested, upon request.

The Garnets is a new belt dressing—at least it is new to most of our readers—which is manufactured by the Garnet Belt Dressing Co., Allentown, Pa. It is put up both in bar and liquid forms, and is said to be superior to any other dressing on the market. The manufacturers have an interesting circular which they will send upon request to anyone interested.

T. T. Burchfield & Co., 610 Betz Building Philadelphia, Pa., are sending out a limited number of the 1903 edition of the Watertown Engine Company's book on engines. The book covers a period of nearly sixty years' experience in engine building, and contains a number of very fine illustrations in connection with an interesting mechanical talk upon the subject of engines. They will be sent free to readers of The PRACTICAL ENGINEER.

The value of protective arch plates for the mouths of boilers has come to be generally recognized, as without the use of a protector the intense heat reflects against the brick work and doors, causing the continual burning out of the fronts. The Lamprey Protective Arch Plate, manufactured by the Lamprey Company, Westfield, Mass., is a device for this purpose second to none. Their booklet, containing much information upon the subject of boiler circulation, brick work and etc., will be mailed free to anyone interested.

A growing business is that of the Keystone Chemical Mfg. Co., manufacturers of Tri-Sodium Phosphate for removing scale from steam boilers. They have recently enlarged their manufacturing plant to three times its former capacity, and during the present month they received, among many others; a single order for 40 tons of Tri-Sodium Phosphate. Another order was received from a well-known Philadelphia concern for 22 barrels, all of which the manufacturers think is the best possible substantiation of their claims that they are producing a water purifier and scale solvent of genuine merit.

A feature of the Bickel Steam Traps which will interest engineers is, that they have the full capacity of the pipe connections. Mr. Bickel is receiving a large number of orders for his traps from capable engineers which he attributes largely to this feature. He has an interesting illustrated circular which he will send to any engineer interested. Address, Fred. L. Bickel, 1348 Palmer St., Philadelphia.

I may be that you don't know that Vici Hydraulic Leathers have advantages which no rubber, celluloid or other substitute can possibly have. If so, you will do well to write E. F. Houghton & Co., 254 West Somerset Street, Philadelphia, Pa., for their booklet on "Vici Leathers for Hydraulic Packings." It will tell you about their packings for dash pot valves, pump valves, washers and blowing engine valves in a way that will interest you.

One of the most serious draw-backs to making fine castings is the adhesion of sand to the metal. If you want to be sure of getting good smooth work free from blow-holes, insist on the foundryman using Dixon Graphite Facings—if he don't know its value, write to the Joseph Dixon Crucible Co., Jersey City, N. J., for their descriptive work on the subject.

Do you want an indicator? If you do, it will doubtless pay you to write to Jas. L. Robertson & Sons, 205 Fulton St., New York, for a copy of their catalogue. They have made a specialty of indicators for many years and much of the valuable information which they have acquired is given in their catalogue, making it extremely valuable to anyone interested in the subject. They will be glad to send a copy to any of our readers free upon request.

The Ward-Corby Co., which is an off-shoot of the Ward-Mackey Co., who operate mammoth bakeries in Pittsburgh, have under way new bread and cracker bakeries in Chicago and Providence, which plants are being supplied each with 150 H. P. boilers furnished by the Pittsburgh Gage & Supply Co., of Pittsburgh.

This concern is also supplying the Pittsburgh Tool & Drop Forge Co., Cheswick, Pa., with one 150 H. P. water tube boiler, as well as the Windsor Hotel, Wheeling, W. Va., with a 65 H. P. water tube boiler.

A new Catalogue, printed on good paper and handsomely illustrated, as is their usual custom, has just been issued by the United States Metallic Packing Co., 13th and Noble Streets, Philadelphia. To engineers interested in the subject of economical piston and valve rod packing, this catalogue will prove both interesting and instructive. The Company will send copies free to any of our readers mentioning this journal.

Water-Tube Boilers while admittedly economical and possessing many points of merit, often among engineers, because of the difficulty of removing scale, The Lagonda Mfg. Co., Springfield, O., have made a special study of this particular difficulty, and the Weinland Tube Cleaner is the product of their thought and efforts. They claim that this cleaner removes the scale perfectly and that it is easily handled, and they have the testimony of scores of engineers and firemen to substantiate them. Any cleaner that will do this is well worth the consideration of owners or operators of Water Tube Boilers.

FROM $1.00 TO $1.50 PER DAY
SAVED BY THE
Cross Oil Filter

Stamps, Ark., Sept., 13, 1902
Burt Mfg. Co., Akron, O.
Gentlemen:—We are very much pleased with the Filters bought of you and have saved from $1.00 to $1.50 per day with them right along. We use all the oil over again, which amounts to about ten gallons a day. The Filters work fine and we would not be without them.
Yours very truly,
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That is what our Filters are doing every twenty-four hours of the day—saving money in large amounts and small, for manufacturing concerns, big and little, in every part of the world. Are you losing money by not owning one? Sold on 30 days' trial.

THE BURT MFG. CO., Akron, Ohio, U. S. A.
Largest Manufacturers of Oil Filters in the World
Cross Oil Filters carried in stock by the
FAIRBANKS CO.
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THE POSITIVE EXPANSION BOLT

Special Discount to Jobbers. Write for Prices
Manufactured by D. C. SEAMAN & CO.
1638 Hutchinson St., Philadelphia, Pa.
For sale by Neal & Brinke, 18 Warren St., New York; Somers, Fiths & Todd Co., 323 Water St., Pittsburgh, Pa.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics. JOHN T. LINDSTROM, 440 Liberty Street, Allentown, Pa.

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PULL
The "P. B. H."
Quick-Closing
Water Gauge

A Pull on the Chain Does it.
Strongly Made.
Low in Price.
Sent on Approval.
Satisfaction Guaranteed.

We also make the
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DIAPHRAGM
GAUGE COCK.

PAUL B. HUYETTE
1245 Betz Building
PHILADELPHIA, PA.

From far off Java comes the following order to Randolph Brandt, 38 Cortland St., New York City:

"Some time ago I wrote you about the fine Selden Packing we received with a pump from America, and I wish you would send me as soon as possible fifty lbs. each of ¾, ½, ¾ and 1-inch."

Removal Notice.—The Keystone Elevator Inspection and Repair Co. have removed from Eleventh and Wood Streets to their large new plant at 923 Locust St., Philadelphia.

The new plant is admirably adapted for their work, and is furnished throughout with the latest improved machinery and tools for elevator construction and repair work of every description. This company is prepared to furnish all kind of elevators for either passenger or freight service, electric, hydraulic, belt or hand-power machines. They are also prepared to furnish and install air cushions and safety appliances of every description at the shortest notice. Their arrangement for doing repair work to all types of elevators is unexcelled. They have a corps of experienced workmen and a full line of modern portable tools ready to go any where in or out of the city at a moment's notice.

The company will be pleased to send their representative to give estimates on any kind of new work or repairs.

To Save Ninety Per Cent. of the money that you spend for new valves to replace leaking ones is a proposition worthy of consideration. W. P. Barnum, 48 Newton St., Fredonia, N. Y., claims that you can do it with one of his Standard Valve Reseating machines, and while it seems like a pretty big claim to make, the testimony of scores of responsible engineers bears out his statement. At that rate the machine would pay for itself in a very short time. Moreover, it is less trouble to reseat a valve in position than to adjust a new one.

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Order the Material you prefer, you run no risk. All our material is guaranteed, or no sale, order to-day.
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Removal Notice.—John R. Livezey, general agent for Nonpareil Cork for steam and brine pipe covering and general insulation, has removed his offices to much larger quarters at 1936 Sansom St., Philadelphia.

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IN every steam plant a Cochrane Feed-Water Heater will effect a saving of from 5 per cent. to over 20 per cent., according to the conditions, whether the plant is operated high pressure, exhausting free to the atmosphere; whether operated under back pressure, using the waste steam for heating or drying, or whether it is operated condensing, even though these plants are equipped with economizers and provided with live steam purifiers. And while making this saving, a Cochrane Feed-Water Heater will eliminate the strains caused by introducing cold water into economizers, live steam purifiers and boilers, which strains are chiefly recognizable in repair bills and stoppages.
Besides insuring the benefits referred to above, a Cochrane Heater will very materially improve any feed supply—no matter how bad—by eliminating some or all of the scale-forming matter present in the water, and by saving the exhaust condensed in accomplishing the heating. Send for Catalogue 16-H.
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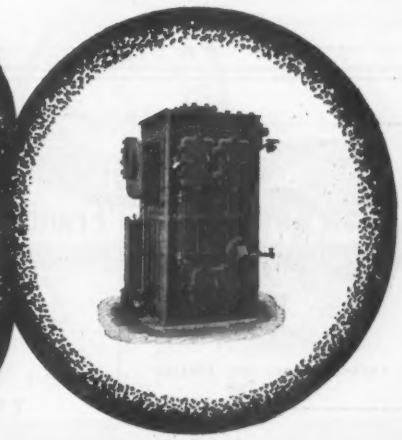

American Order of Steam Engineers.

ORGANIZED APRIL 27, 1886.

An Order of Engineesr for Engineers and Engineers only.

DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them ; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.—To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

MEMBERSHIP.

An applicant for membership must be an engineer between twenty-one and fifty years of age, and must be a white male citizen of the United States, of good moral character and be a believer in the Supreme Being, and be free from all physical infirmities.

He must have had three years' service in an engineering department, or if a machinist, or graduate of a technical institute, then, one year's service, in such department, and in localities where engineers are required by law to be licensed, they must have such license, and must satisfy the investigating and examining committees of the council to which he applies as to his character and ability.

LIFE MEMBERSHIP.

Engineers who have passed the age limit may be admitted to life membership. They must possess the same qualifications and pass the same examination as are required in the next proceeding clause : They shall be entitled to all rights and privileges of the Order except they cannot vote on financial questions or for the election of officers or be entitled to any sick or death benefits.

DIRECTORY.

The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting to the Secretary of the Publication Committee immediately after each election of officers. Address J. C. McDowell, Secretary, in care of "The Practical Engineer," 1215 Filbert Street, Philadelphia.

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Maryland Council, No. 1, meets 2d and 4th Fridays in Royal Arcanium Hall. Chief Engineer, J. C. W. Schrier. Corresponding Engineer, Wm. S. Smith, 116 W. Lee Street.

Energy Council, No. 2, meets every Wednesday of each month in Bauer Hall, Cheaspeak and Elliott Sts. Chief Engineer, Philip A. Kirkwood. Corresponding Engineer, Jos. H. Stallings 3062 Dillon St.

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Orange Council, No. 9, Meets 2d and 4th Fridays. Chief Engineer, Chas. Gartrell; Corresponding Engineer, Fred. L. Hale.

Rockland.

Old Colony Council, No. 14, meets second and fourth Saturdays in the American Foresters' Hall. Chief Engineer, E. H. Naylor. Corresponding Engineer, Chas. W. Alden, Box. 642 North Abington.

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Camden Council, No. 3, meets every Thursday evening at N. E. corner 2d and Federal Street. Chief Engineer, S. R. Middleton. Corresponding Engineer. C. H. Pfeiffer, 571 Berkley St.

Atlantic City.

Atlantic City No. 4 meets every Tuesday evening at Merchants, Cor. Atlantic and New York Avenues. Chief Engineer, R. Endicott. Corresponding Engineer, W. S. Price, Haddon Hall.

Bridgeton.

Bridgeton Council, No. 5, meets every Friday. Chief Engineer, David Sellers. Corresponding Engineer Francis O. Garrison, Bridgeton, N. J.

Millville.

Millville Council, No. 6, meets every Saturday, 7.30 p. m., in G. A. R. Hall, East Main St. Chief Engineer, Geo. Esabel Corresponding Engineer, Lewis Doughty, 604 Mulberry Street.

NEW YORK.

Syracuse.

John E. Sweet Council, No. 6, meets Monday, Room 23, Nottingham Block, East Washington Street. Chief Engineer, John Cunningham. Corresponding Engineer, S. A. Steel, 311 Orange street.

PENNSYLVANIA.

Grand Chief Engineer, Hiram Trout, 1105 North Tenth street, Reading, Pa. Grand Corresponding Engineer Frederick Markoe, 931 Orianna street, Philadelphia.

Philadelphia.

Deputy Grand Chief for Western Pennsylvania, A. D. Hamilton, 2025 Forbes Street, Pittsburg, Pa.

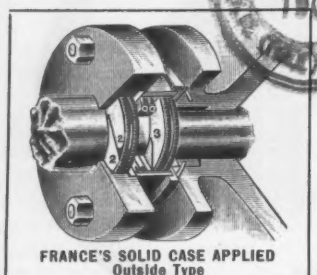
Germantown Council No. 22 meets every Wednesday evening at Main and Seymour Streets, Germantown; Chief Engineer, John P. Rickards; Corresponding Engineer, Frank MacIndoe, 3529 Ainslie St., Falls of Schuylkill, Philadelphia.

Welcome Council, No. 2, meets every Friday, N. W. Cor. 12th Street and Columbia Avenue. Chief Engineer, Paul Pieling. Corresponding Engineer, L. D. Woodington, 2428 N. Bancroft St.

Kensington Council, No. 3, meets every Thursday, at A. P. A. Hall, Frankford Avenue and Master St. Chief Engineer David J. Ezrah. Corresponding Engineer, Charles Fournier, 3115 Richmond St., Philadelphia.

Southwark Council, No. 4, meets every Monday, at corner of Reed and Eighth Streets. Chief Engineer, Joseph Hynes. Corresponding Engineer, J. C. McDowell, 1913 S. 8th Street.

(Continued on page 28.)



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A Sensible King

Old King Coal was a merry old soul,
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But waste in his pile made a big, big hole,
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For P. P. P. stops the friction leaks,
And happy King Coal is he!

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Instead of holding the rod in a tight grip as solid packings do, the sliding wedges of "P. P. P." adjust themselves to the rod with the least possible pressure. What it saves in fuel is told by Mr. Geo. T. Gilbert, Chief Engineer for Forbes & Wallace, Springfield, Mass., who says:

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FREE—Our patent steel packing rule saves engineers labor, time, trouble, temper, packing, burnt fingers and swear words. It is worth $1.00. Sent absolutely FREE to engineers who order from us enough "P. P. P." for a trial, and mention this paper.

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DIRECTORY OF COUNCILS CONTINUED.

Philadelphia Council, No. 7, meets every Wednesday, at Kenny's Hall, N. W. cor. Broad and Filbert Sts. Chief Engineer, Jas. J. Murphy. Corresponding Engineer, W. S. Wetzler, 3707 Aspen St.

Manayunk Council, No. 9, meets second and fourth Friday evenings in Temperance Hall. Chief Engineer, Richard Wallace. Corresponding Engineer, John Clevenger, 211 Lofty Street.

Helping Hand Council, No. 12, meets every Thursday evening at Kensingon Ave., and C Streets. Chief Engineer, Edward Laurence. Corresponding Engineer, Frank McHugh, 2503 Tulip St. All correspondence should be addressed direct to the Council.

Municipal P. F. D. Council, No. 20, of Philadelphia, meets the second Thursday of each month at Odd Fellows' Hall, Third and Brown Streets. Chief Engineer, Frederick Markoe. Corresponding Engineer, Walter Meyers, 1211 North Howard Street.

Pittsburg.
Iron City Council No. 21 meets every Saturday at 1070 Fifth Avenue. Chief Engineer, Phillip W. Sutton. Corresponding Engineer, F. C. Rose, care of St. Paul's Orphan Asylum, Idlewood, Pa.

Girardville.
Girard Council, No. 8, meets every Tuesday evening at O'Neill's Hall, 2nd and Ogden Sts. Chief Engineer, Jacob Weber. Corresponding Engineer, M. J. Carey, Lock Box 214.

Allentown.
Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Chief Engineer, Wm. R. Smith. Corresponding Engineer, A. P. Driesbach, 728 Chew Street.

Pottstown.
Pottstown Council, No. 14, meets first and third Saturday evening at P. O. S. of A. Hall, corner High and Hanover Sts. Chief Engineer, Joseph Rhoads, Corres., Engineer, H. L. Shirey, 362 Cherry St.

Reading.
Progress Council, No. 13, meets every Saturday evening at Diebert Hall, 9th and Penn Sts., Room 4. Chief Engineer, Geo. W. Miller. Corresponding Engineer, Frank S. Miller, 8 W Franklin St.

Chester.
Delaware County Council, No. 6, meets every Wednesday evening in the Carpenter Hall, 6th and Wall St. Chief Engineer, John Canavan. Corresponding Engineer, E. E. McCoy, 2222 West 3d Street.

York.
York Council, No. 16, meets every Wednesday evening in the Jordan Block. Chief Engineer, A. L. Bair. Corresponding Engineer, Walter H. Long, 28 East Philadelphia Street.

Harrisburg.
Capitol City Council, No. 17, meets every Tuesday evening in Red Men's Hall, Market Street, above Second. Chief Engineer, B. H. Shafer. Corresponding Engineer, S. Filson, 1126 Market Street.

Columbia.
Columbia Council, No. 18, meets every first and third Saturdays, in Odd Fellows' Hall. Chief Engineer, Ruben Beard. Corresponding Engineer, W. J. Courtney, 804 Walnut Street.

Sunbury.
Sunbury Council, No. 19, meets every second and fourth Saturday in Zartman's Hall. Chief Engineer, S. E. Lees. Corresponding Engineer, Ed. Schrieber.

WISCONSIN.

Deputy Supreme Chief Engineer, Joseph P. Harris, No. 1611 Clybourn Street, Milwaukee.

Milwaukee.
Washington Council, No. 1, meets every Saturday at 207 Grand Avenue. Chief Engineer, J. B. Chambers. Corresponding Engineer, James A. Rigby, 136 Reed Street.

Clifford P. Williams Council, No. 2, meets every Thursday evening 298 4th Street. Chief Engineer, David T. Richardson. Corresponding Engineer, Jas. T. Harris, 1611 Clybourn Street.

TENNESSEE.

Deputy Supreme Chief Engineer, John B. Mullen, 826 Central Ave., Nashville.

Nashville.
Enterprise Council, No. 1, meets every Friday evening in the Twin Building on Cedar St. Chief Engineer, J. J. Johnson. Corresponding Engineer, Jno. B. Mullen, 209 Jackson Building.

OREGON.

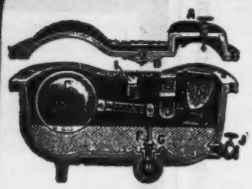
Deputy Supreme Chief Engineer, Nat Freese, Grant's Pass, Oregon.

Grant's Pass.
Oregon Council No. 1. Chief Engineer, William H. Kenny. Corresponding Engineer, Nat Freese. Meets every first and third Saturday. A. O. U. W. Hall, Main St.

TEXAS.

Deputy Supreme Chief Engineer, S. A. Bishery, care of Cotton Compress and Warehouse Co., Galveston.

Galveston.
Galveston Council No. 1 meets every second and fourth Tuesday evening at Engineers Hall, So. West corner 22nd and Strand Streets. Chief Engineer, Max Levy; Corresponding Engineer A. L. Bradford, Union Depot.



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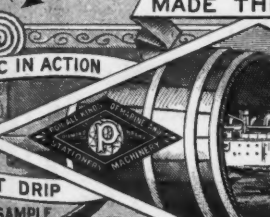

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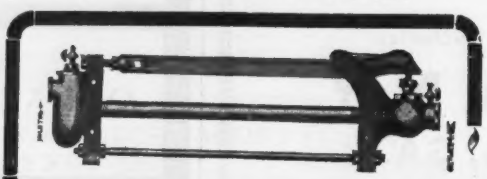

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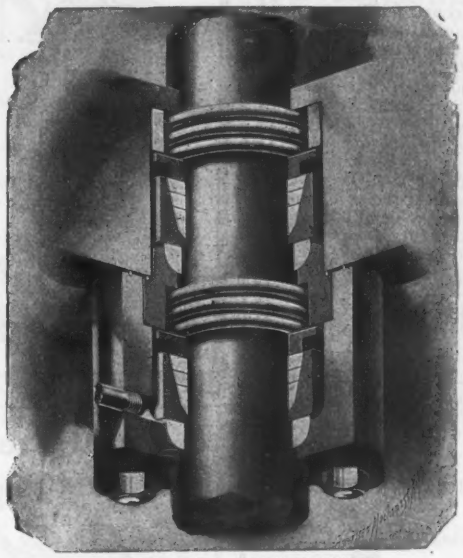

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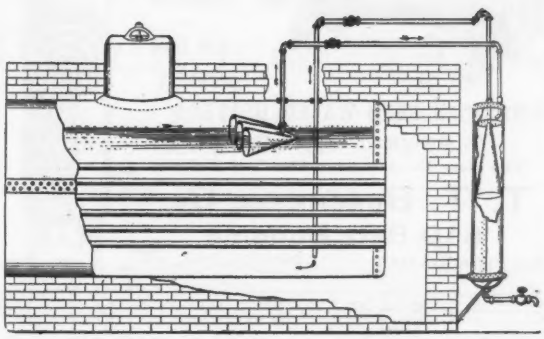

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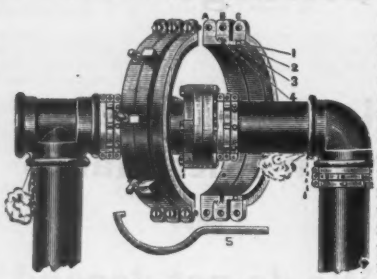

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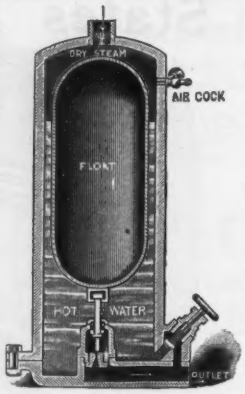

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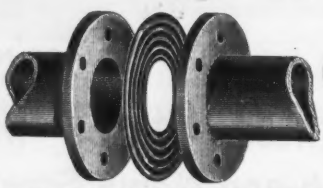

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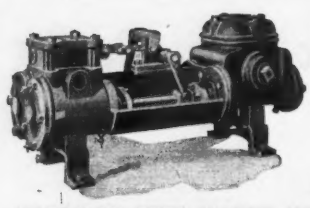

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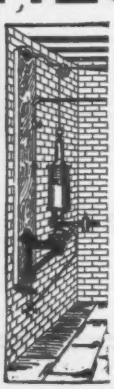

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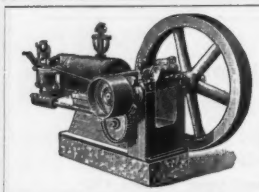

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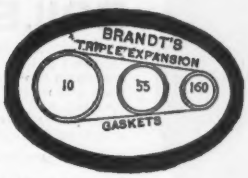

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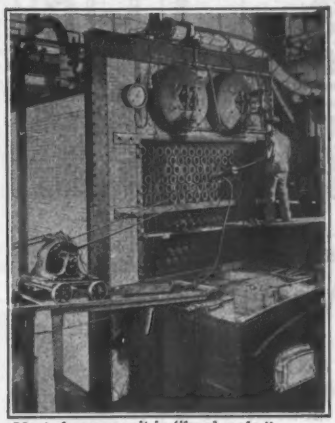

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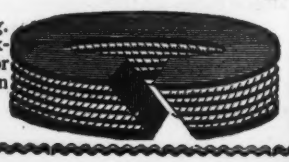
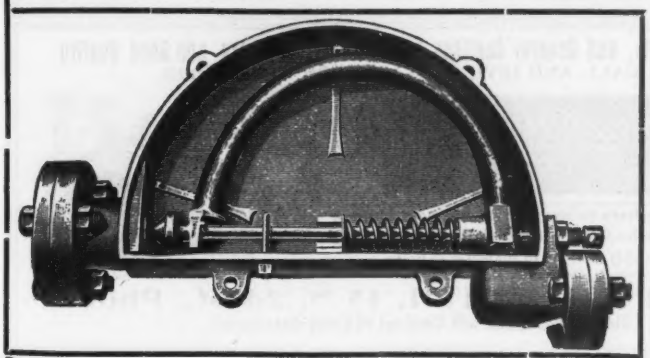


The Gould Packing Co., East Cambridge, Mass. **Albion Chipman, Treas.**



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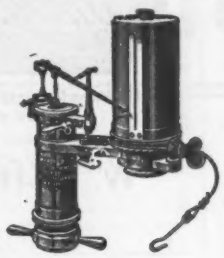

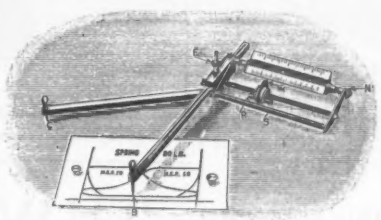

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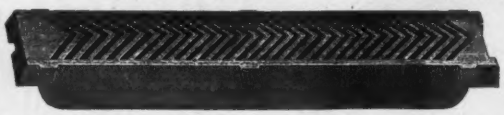

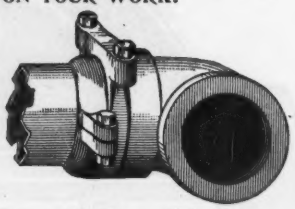

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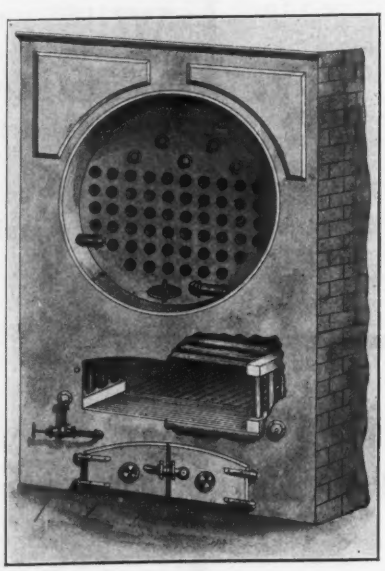

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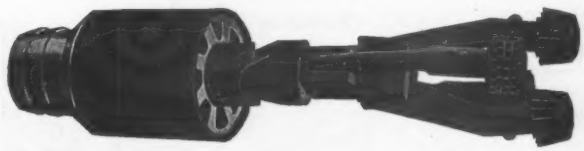

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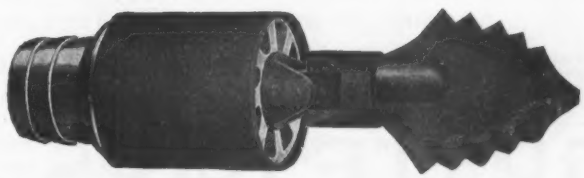
When equipped with the DRILL, which is interchangeable with the swinging arms, tubes which are entirely STOPPED UP with scale may be cleaned.



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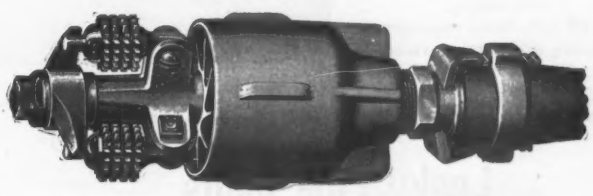

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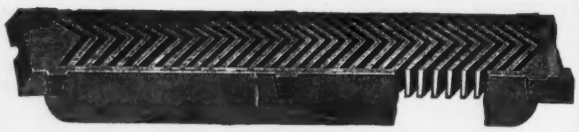

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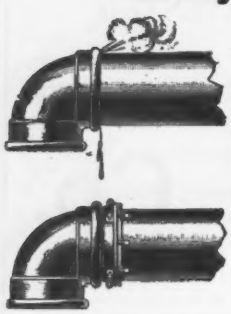

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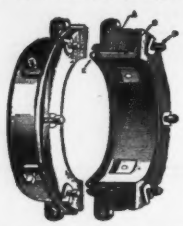

A—Outside or main ring which is bolted around the pipe as close to leaky joint as possible, and secured to pipe by the set screws.
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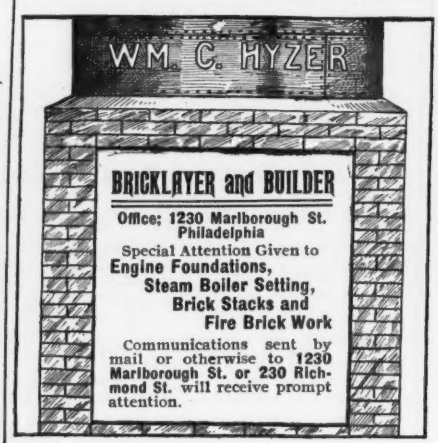
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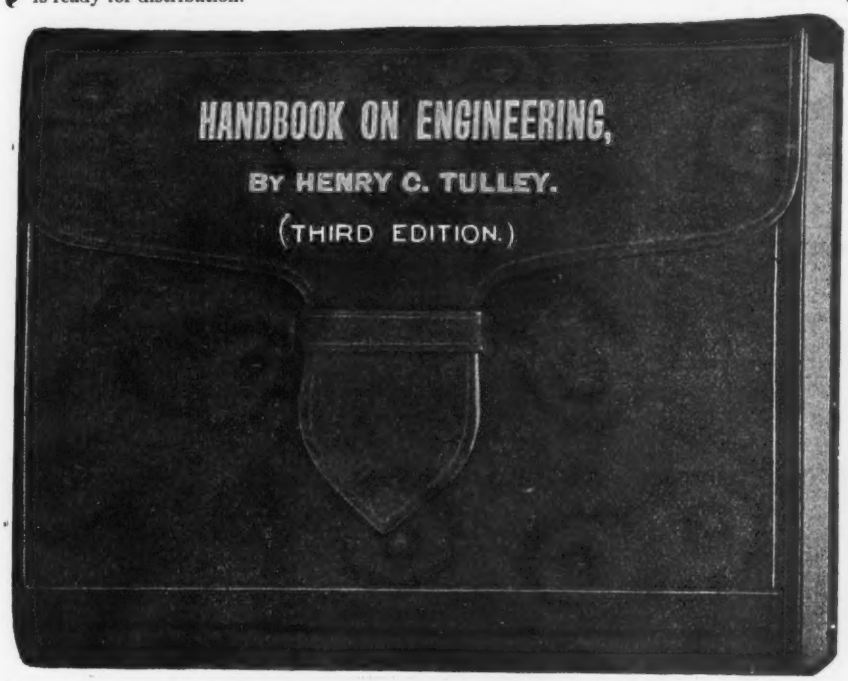

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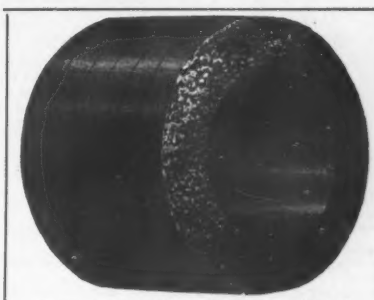

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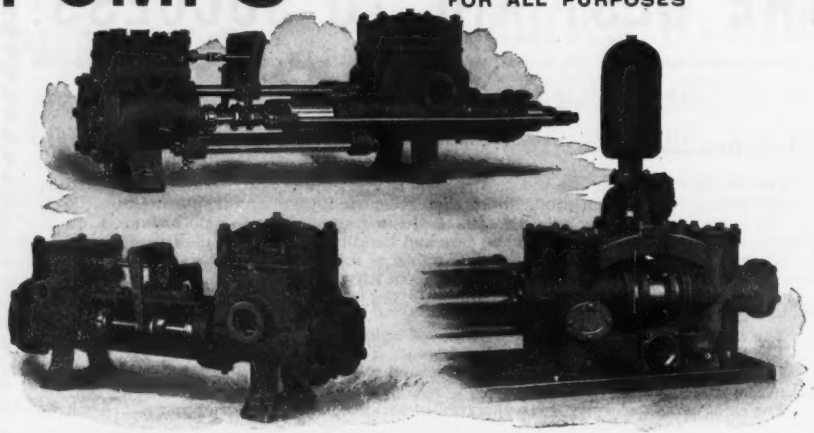

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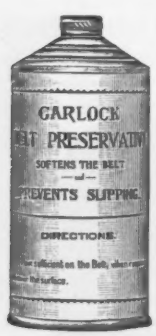

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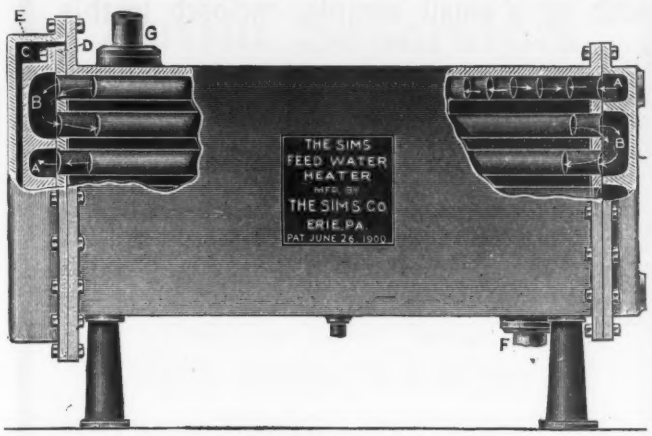

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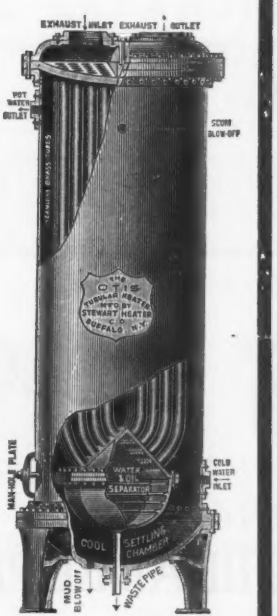

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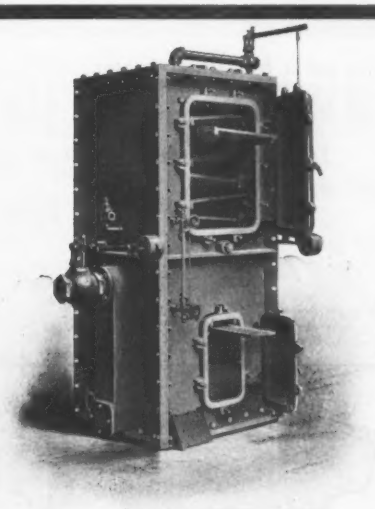

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How often do you clean boilers?.....

Do you blow out or wash out all sediment each time?.....

How often do you open the blow-off while at work?.....

How long do you keep it open?.....

Name the river or source of your water supply?.....

Does the feed-pipe clog up or form scale?.....

Do you use a feed-water heater?.....

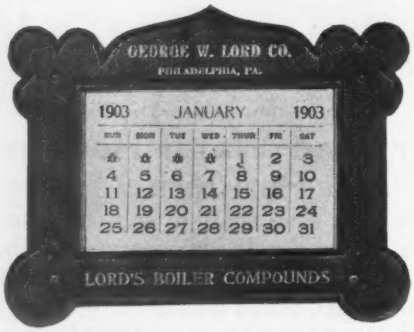
Do you run day and night?.....

If sample of scale is sent in separate packages, please mark same with your name and address.

Your name.....

Address.....

Firm name.....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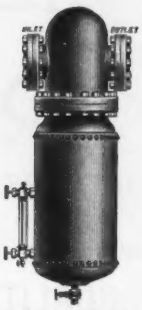

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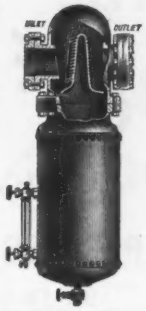

"Sectional View Figure L, Separator"

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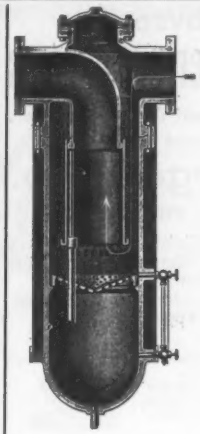


Thousands...

Of little gutters are provided in **Sweet's Separator** for conducting the oil and water from the steam current and not a drop can get back. This is only one of many reasons why 50 per cent. of them are sold on duplicate orders.

2,700 in Use, All Styles

Let us Send Our Story

WE ALSO MAKE

EXHAUST HEADS & STEAM TRAPS

Direct Separator Co.

200 Marcellus St.

SYRACUSE, NEW YORK

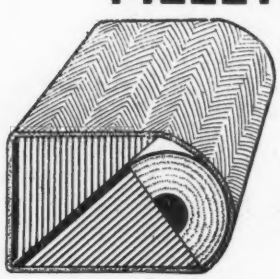
—40 Per Cent. Saved—

PILLEY'S EXPANSION WEDGE PACKING

THE ONLY PACKING HAVING A PERFECT EXPANSION AND PRACTICAL WEDGE MADE IN 12-FOOT LENGTHS OR

CUT AND MOULDED INTO RINGS

TO FIT YOUR RODS



Latest and Best

This is the most economical wedge packing on the market, and as it is not **loaded** with **unnecessary** Oil and Tallow it weighs about one-half per foot of other wedge packing, thus making a saving of fully 40 per cent. in cost of packing

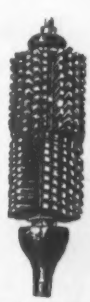
Also Sole Manufacturers of

PILLEY'S IMPROVED RING PACKING

Sent on Thirty Days' Trial to Responsible Parties

See that this trade mark is on all Pilley's Packings

Showing Construction of Brush



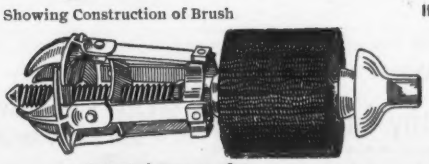
Brush ready for use

A RECORD FOR RELIABILITY IS BEHIND THE IMPROVED

Pilley Expansion Flue Brush

It is Guaranteed Not to Break, Being made of Malleable Iron and Tempered Steel

It Cleans the Entire Flue Every Time It Is Pushed Through



Patented June 14, 1892

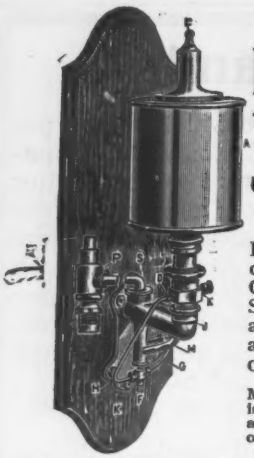
Keep your tubes clean and saves money. **Pilley's Combination Flue Brush and Scraper** is the simplest and best cleaner on the market. A simple turn of the hand adjusts it to the tube and the brush removes what the scraper loosens. Guaranteed not to break nor the wires come out or lay over. Sizes from 2 inches up. Measure outside diameter of tube.

PILLEY PACKING AND FLUE BRUSH MFG COMPANY, 308 N. Main St., St. Louis, Mo.

——For Sale by——

Tatum and Bowen, San Francisco, Cal; Portland, Ore., and Seattle, Wash. Crane Co., New York City. S. H. Supply Co., Denver, Colo. Eagle Oil and Supply Co., Boston, Mass. Chas. Bond, 522 Arch St., Philadelphia, Pa. Scranton Mercantile Co., Scranton, Pa. Strong Machinery and Supply New York City. New Orleans Railway and Supply Co., New Orleans, La.

Send for Our 70-Page Memorandum Book—FREE TO ENGINEERS



IMPROVED

Kellam Damper Regulators

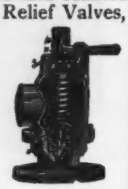
The Simplest and Closest Damper Regulator.

Manufactured by

J. E. Lonergan & Co.

211 RACE ST., PHILA., PA.

Brass Founders and Finishers and Makers of Pop Safety Valves, Water Relief Valves, Oil Cups and Lubricators, Steam Pressure Regulators and other safety steam appliances.



Old Kellam Regulators Repaired. Correspondence Solicited. Mention this paper if your inquiry is prompted by the sight of this advertisement. Catalogue D free on application.

ESTABLISHED 1871.

J. & G. RICH

General Machinists

ENGINE BUILDERS

AND DEALERS IN MACHINERY.

Especial Attention Given to Repairing and Erecting Steam Engines, Pumps and Other Machinery, Shafting, Hangers, Pulleys, Etc., Etc.

120 North Sixth Street, Philadelphia, Penna.

TELEPHONE No. 380.

5 GAL. SIGHT-FEED

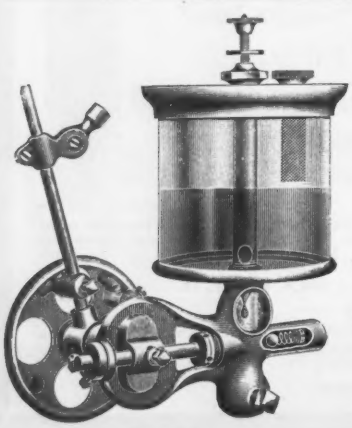
LUBRICATOR

illustrated here is designed for Single Engines or Large Plants where many Engines are operated from one steam main. It will oil one or a dozen Engines, save 40 per cent. of Oil used with any other Lubricator, and prevent annoying leaks in Steam Pipes.

CHAS. H. SMITH, JR., General Agent,

Lackawanna Lubricator and Mfg. Co.,

P. O. Box 478. WILMINGTON, DEL.



Manzel Sight Feed

Automatic Oil Pump

½ Pint to 1 Gallon

One to Six Feeds

Made in all sizes. Friction movement. Noiseless in operation. Recommended and used by nearly all the prominent engine builders and sent on 30 days' trial. Suppose you get our Catalog and prices.

MANZEL BROS.,

50 & 52 Broadway,

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O. F. Zurn
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HIGH-GRADE

LUBRICATING OILS AND GREASES

PEERLESS Boiler Cleaning Compounds

Our First and Last Consideration is **QUALITY**

408 to 418 VINE ST., PHILADELPHIA

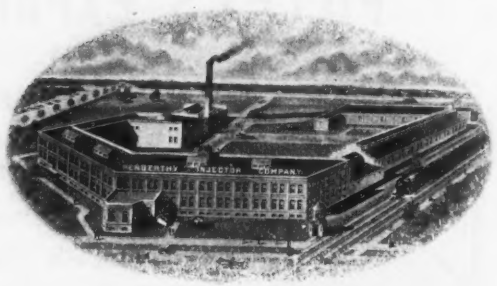
THE STAMP AIR INJECTOR

is the best, most reliable, cheapest, and is so acknowledged by elevator builders and engineers who are using it. It does its work easier and with less trouble than any other device know to them for supplying elevator pressure tanks with air. If this INJECTOR does not give satisfaction after 30 days trial, same can be returned. A liberal discount quoted to the trade, also to consumers.

Write for
Illustrated Catalogue and Testimonials

JOHN G. STAMP
CHIEF ENGINEER, 202 MAIN ST. BUFFALO N.Y.

THE NEW HOME OF THE



WORLD RENOWNED

TRADE **PENBERTHY** MARK.

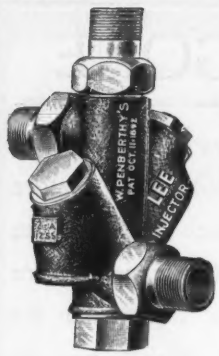
AUTOMATIC INJECTOR

Our new factory, just completed, is one of the finest brass manufacturing plants in the United States, being equipped throughout with the latest improvements in brass working machinery, including electric distribution of power. We are now prepared to take prompt care of all orders, and shall aim to make the "Penberthy" in the future, as it has been in the past, the

STANDARD AUTOMATIC INJECTOR OF THE WORLD

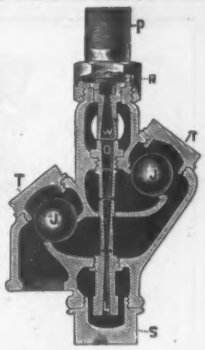
Penberthy Injector Co. 356-362 HOLDEN AVENUE DETROIT, MICH.

Largest Injector Manufacturers in the World.

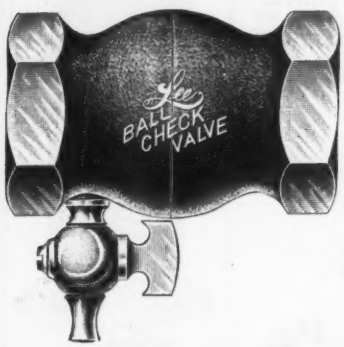


BALL VALVE *The Lee* PATENT AUTOMATIC

INJECTOR



PERFECTION HAS NOT A SUPERIOR SIMPLICITY



HAS NO EQUAL

The Lee PATENT

STRAIGHT-WAY

HORIZONTAL AND ANGLE

BALL CHECK VALVES

SEND FOR CATALOGUES

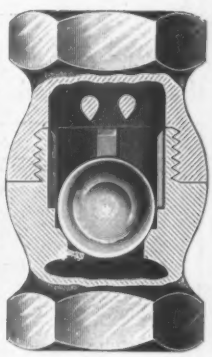
MANUFACTURED BY

The Lee Injector Mfg. Co.

99-101 ABBOTT ST.

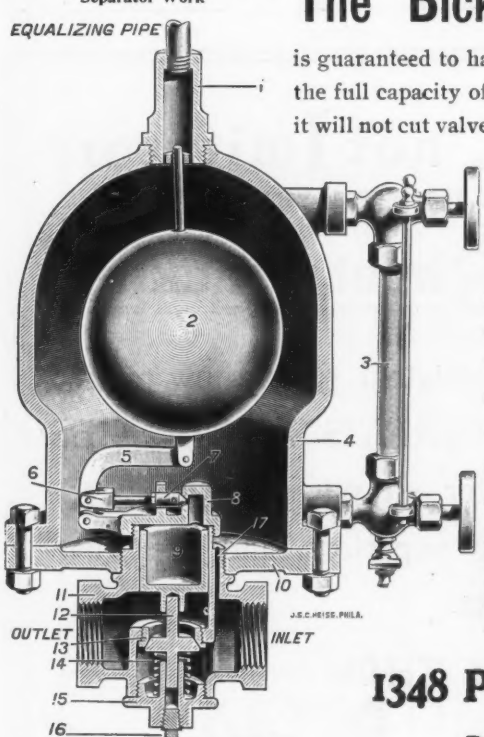
DETROIT, - MICH.

SUPERIOR TO ALL



This Trap is Specially Adapted for Separator Work

EQUALIZING PIPE



Patented Feb. 26th and Dec. 10th, 1901

THE BICKEL FLOAT STEAM TRAP

For Pressures from 5 to 300 lbs.

The Bickel Float Steam Trap

is guaranteed to handle more water than any trap made. It has the full capacity of pipe connections. It will respond instantly; it will not cut valves, and is **specially adapted for Separators.**

The Bickel Thermostatic Steam Trap

is not adapted for Separator use or bleeding steam mains, but is unexcelled for every other service to which a trap can be put. It will respond quicker and last longer than any other expansion trap. Can be set to discharge water at any temperature. Will not cut valves.

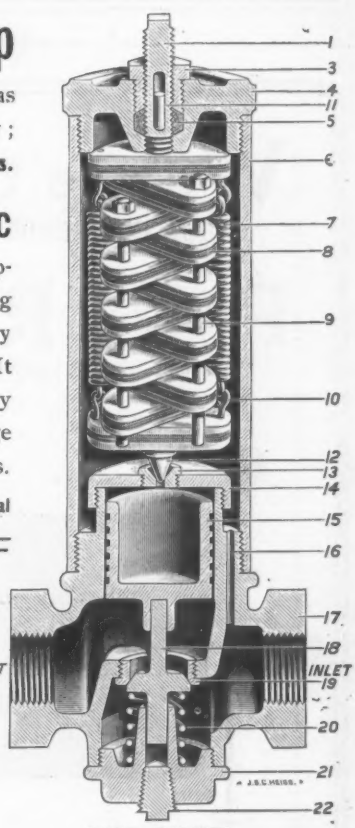
Either of these Traps sent to responsible parties on trial

FRED. L. BICKEL

1348 PALMER STREET

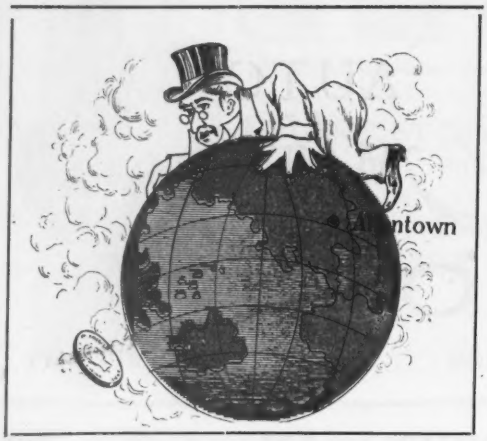
PHILADELPHIA, PA.

REPRESENTATIVES WANTED IN ALL CITIES



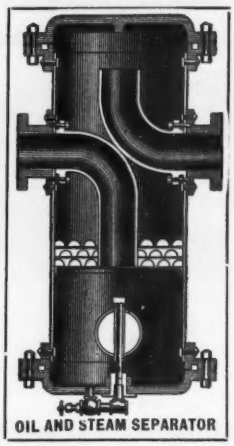
THE BICKEL THERMOSTATIC STEAM TRAP

For Pressure from 5 to 300 lbs.



THAT ONE IS GONE

But there are lots of other good, hard dollars you can get, if you go after them right, and in the pursuit and capture of these dollars nothing will aid so much as, A Steam and Oil Separator equipped with automatic trap inside or a Separator in side of your boiler which will keep the water in your boiler, or a Steam Trap which has no pins, screws, or valves, that can stop up, or to have your steam cylinder re-bored and fitted with steam tight packing rings. This kind cost no more than poor kind, but pays a lot better. May I see you about it?



OIL AND STEAM SEPARATOR

FOR INTERIOR OF BOILER

John T. Lindstrom,

440 Liberty St., Allentown, Pa.

We are the Originators, not Imitators

Are INDEPENDENT of any Trust or Combination, and the general verdict is that

Perry's Red and Brown Sheet Packings

are the only old and original goods now offered to the trade, and that PERRY'S SPECIALTIES in Steam Packings, for all purposes, are made upon honor, have no superiors, and are guaranteed in every respect.

TRY THEM

Manufactured by the

La Favorite Rubber Mfg. Co.

PATERSON, N. J.

Read this Letter from a Prominent Philadelphia Engineer giving his Experience with

KEYSTONE GREASE

NOVEMBER 3rd, 1902.

KEYSTONE LUBRICATING CO., of Phila.

Gentlemen :

For over two years I have had trouble with hot bearings on my engine, I tried oils of every quality with the same results, I also tried grease but was about giving it up also, when I received a sample of Keystone Grease ; however, I gave it a trial and to-day my entire engine is working exclusively with Keystone Grease, and I have cool bearings also, which I never had with oil, and I attribute the change to Keystone Grease, which I highly recommend as it has given me entire satisfaction wherever I used it.

Gentlemen I can say it is all that you claim and is always clean.

Respectfully yours,

ROBERT WARK, C. Engineer.

For Chelten Mfg. Co., Germantown, Phila.

Mr. Wark is only one of many thousands of engineers who have been helped out of trouble, or found economical results from the use of Keystone. You may be another if you will let us send you for trial,

A Sample Can of Keystone Grease and a Keystone Brass Cup, Free Express Prepaid

One pound of Keystone Grease will go as far as three or four gallons of oil, and from three to five times further than any other grease.

Send at Once and Mention This Paper

KEYSTONE LUBRICATING CO.

20th & Allegheny Avenue, Philadelphia, Pa.

HOUGHTON'S MONTHLY LETTER TO ENGINEERS

Dear Mr. Engineer:

"The woods are full of 'em."

We mean packings.

Enough varieties to set one insane in trying to remember the brands.

Each claims to be the best, because it is different from the other fellow's.

Here is another, but we think our arguments are a little different, and our product rather along an original line.

You know what a VICI KID shoe is?

You know it is almost everlasting in wear and entirely waterproof.

Now we take the heaviest steer hides and apply precisely the same process of tannage thereto; at least, Robert H. Foererder, the originator and sole user of the VICI process of tannage, does this.

Then we make this well known, strongest of all leathers into crimped plunger packings, hydraulic cups, dash-pot cups, washers, flange packings and all forms where leather packings have heretofore been used.

Please remember, that we do not offer you asbestos, rubber, flax or other substitute for leather—merely leather, produced by the very best process known, and the one process that is acknowledged the world over as producing the very strongest leather

The superiority of our packings is primarily due to the quality of the leather from which they are made, but the special machinery and the process employed in making the packings has much to do with the question of quality also.

It is a fact that the majority of packings made from leather are produced from old leather that can be bought at a low price—waste from shoe works, belt works, etc., certainly not fit to put in anything requiring strength, is sold to the leather packing makers.

We have adopted a different method and have produced packings from the very best leather made and from the most select portions of the hides.

That there is sufficient number of engineers appreciating the quality of VICI is shown by the fact that we have had to increase the capacity of our plant several times since we opened it.

We guarantee twice the life for VICI leather packings. You will probably obtain ten times the wear.

Send us your requirements and we will quote you price upon same and send you a catalog with particulars.

The Jewell Belting Co., of Hartford, Chicago and Philadelphia, has the exclusive privilege of making VICI belt. Write to them if you want to know something interesting on the subject of belt.

Jewell Belting Co., 10 Trumbull St., Hartford, Conn.
Jewell Belting Co., 184 Lake Street., Chicago, Ill.
Jewell Belting Co., 254 W. Somerset St., Philadelphia, Pa.

JOHN J. SPROUL, Vice-President and Manager W. J. GREENHOUGH, Secretary and Treasurer

HAVE YOUR

ELEVATORS

REPAIRED

—BY—

Keystone Elevator Inspection and Repair Co.

Removed to 923 Locust St., Philadelphia

Bell, 3-22-58 BOTH PHONES Keystone, Race 10-20

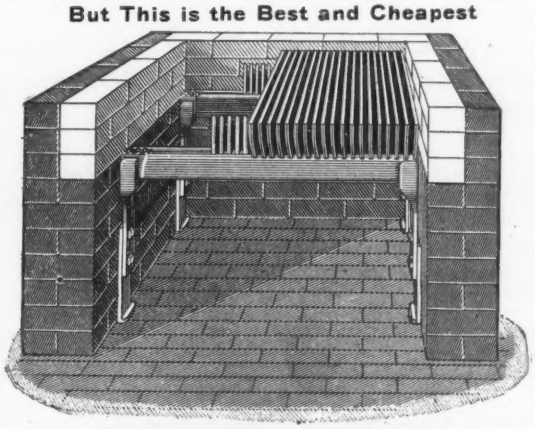
We Carry Repair Parts in Stock, and Will Work Holidays and Nights When Necessary

ESTIMATES ON NEW WORK

WE MAKE ALL TYPES OF

GRATE BARS

But This is the Best and Cheapest



The Longest-lived Grate Bar That Ever Lived.

IMPROVED AMERICAN GRATE BARS

PATENTED.

THE ONLY GRATE WITH ADJUSTABLE FRAME.

THE ONLY GRATE WITH LOOSE TEETH BETWEEN THE BARS.

We wish to call your attention to a few important points in our new Furnace Grates.

The adjustable supporting frame, not coming in contact with the brick-work, saves the walls from getting loose, and can be adjusted to any height desired. The perforated supporting cross bar has less obstruction to a free circulation of air than any other Cross Bar made. The movable teeth between the Grate bars can easily be changed at any time, so as to give an air space between the bars that is desired to accommodate any size of fuel; the Movable Teeth also give the bars more freedom to expand and contract, thereby the bars are less liable to warp.

The American Grate Bars have given satisfaction where others have failed. Are made and for sale only by us; other parties have no right to make or sell them. **Send for circular and references.**

E. J. MOORE MACHINE and FOUNDRY CO.,

SOLE MANUFACTURERS,

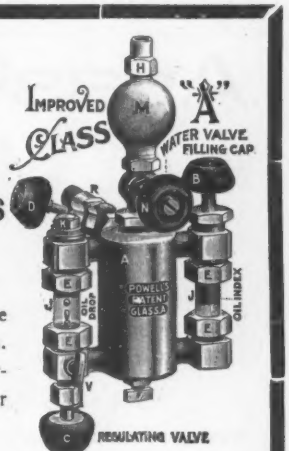
2235-2227 WOOD STREET PHILADELPHIA, U. S. A.

POWELL'S

SIGHT FEED

CYLINDER LUBRICATORS

and Valves



REDUCES to a minimum the friction on Steam Engines. We sell them with a guarantee to work to your satisfaction or your money refunded.

Wrought Iron Pipe

NOT STEEL

Cut to any size and for any purpose. Prompt Shipments to any part of the world guaranteed

Engineers Supplies and Steam Fitters Tools

C. J. RAINEAR & CO.,

No. 518 ARCH STREET - - - Philadelphia

YOU CAN SAVE 90 PER CENT. OF YOUR VALVE BILLS

BY USING

The Standard Valve Reseating Machine

The Standard is guaranteed to reseat all kinds of flat and taper Valves without disconnecting them from the pipe.

They are shipped on trial, and are the lowest priced machines on the market.

They are the simplest, easiest operated, and have the fewest parts.

Catalogue for the Asking.

W. P. BARNUM 43 Newton St., FREDONIA, N. Y.

WE MAKE A SPECIALTY OF MANUFACTURING

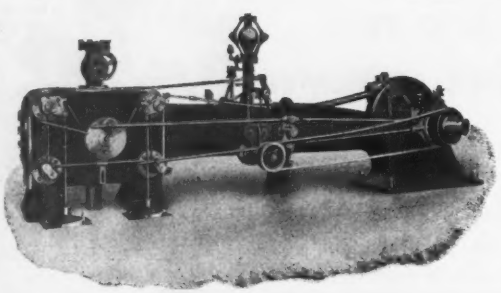
Pure Tri-Sodium Phosphate

FOR REMOVING SCALE FROM STEAM BOILERS...
OUR PRICES WILL BE QUOTED UPON APPLICATION

NATIONAL CHEMICAL COMPANY

Chestnut Hill, - - - - - - - Philadelphia, Pa.

Atlas Engines and Boilers

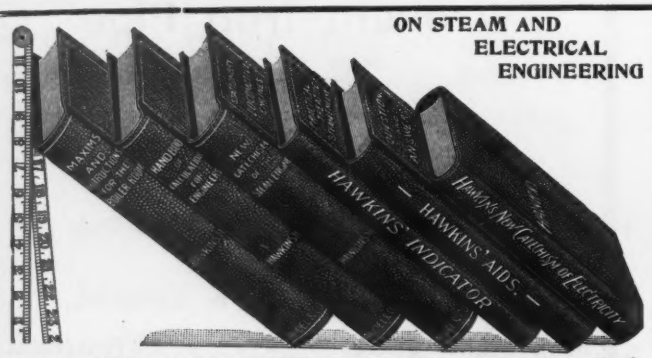


We make many types and sizes of horizontal steam engines and boilers, but every one of them is the best that good materials and high-grade workmanship can make.

CATALOGUES FOR THE ASKING

Atlas Engine Works.

DEPT. P *Indianapolis.*



ON STEAM AND ELECTRICAL ENGINEERING

THEO. AUDEL & CO., Publishers, 63 Fifth Avenue, New York

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"HAWKIN'S EDUCATIONAL WORKS"

$1 Monthly, $11 Per Set. Standard Books for Practical Men

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Terms:—Cut out blank and fill in name, address and reference, mailing it to address named below, and the complete set will be shipped to any address, express paid; after books are received balance can be remitted, $1.00 per month.

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TRADE MARK

BOILER SCALE

REGISTERED

AND CORROSION

The admitted CAUSE of ninety per cent. of all boiler trouble and the only remedy that works successfully with all waters, is pure

KEYSTONE
TRI-SODIUM PHOSPHATE

Even manufacturers of **Boiler Compounds** have been forced to admit this fact, and are now claiming to use tri-sodium as a basis for their product—don't be deceived—it is not "Keystone" Tri-sodium, that is why they have to mix it with other chemicals that apparently clean the boiler, yet as surely destroys the skin of the iron and prepares the way for rapid deterioration

DON'T BE DECEIVED

By small concerns offering Tri-Sodium Phosphate for use in steam boilers, it is not the "Keystone" brand of which we are the patentees, we also have the largest plant in the world devoted to the manufacture of this article, and are consequently in a position to make it profitable for you to deal direct with

KEYSTONE CHEMICAL MFG. CO.

Camden, N. J.

TRADE MARK

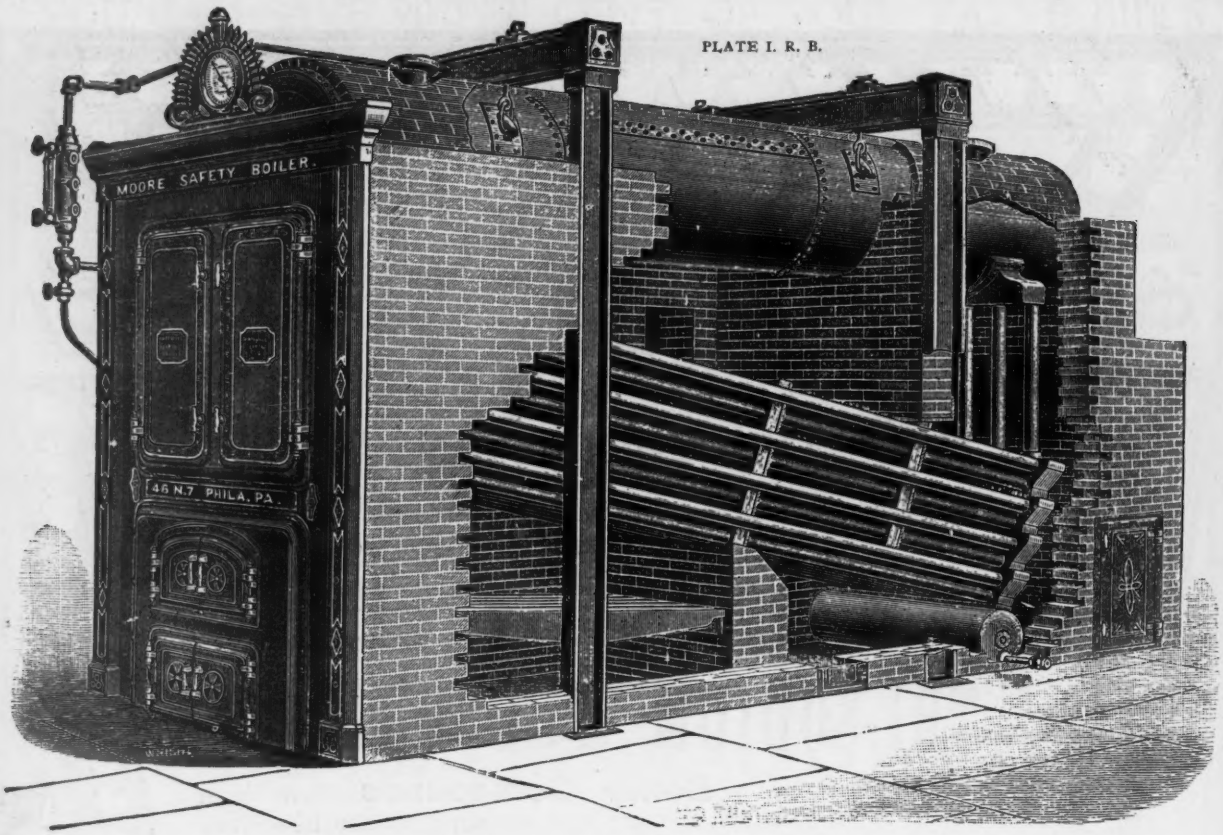
Remember the **None Other Genuine**

REGISTERED

Send a Sample of Your Feed Water for Analysis Free

Send for our Booklet "WORTH KNOWING" Free to Engineers

PLATE I. R. B.



MOORE'S HIGH PRESSURE SAFETY STEAM BOILERS, 800,000 H. P. in use, both in Europe and America

Repairs of Water Tubes. Boilers of all types a specialty. We have special tools for this purpose.

We keep constantly on hand ready for shipment 1000 horse-power. There can be no delay. Send for Catalogue.

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MACHINISTS, FOUNDERS & PATTERN MAKERS

Gray-White, Semi-Steel Aluminum Alloy Castings. Mills and Pulverizers for Minerals, Cereals, &c.
Stamping and Embossing Presses, Roller Mills.

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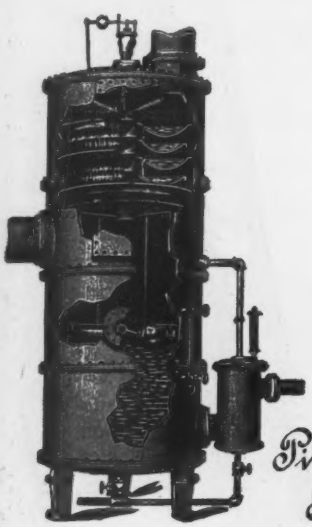

Bonar Gauge Cocks.
Bonar Oil Filters.

Steam Appliances

Pittsburgh Feed Water Heaters.

James Bonar and Co.
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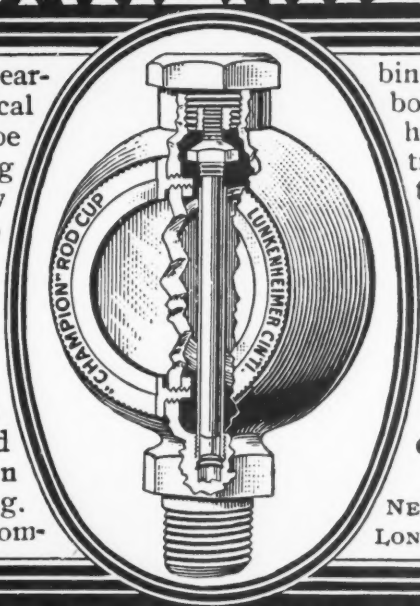

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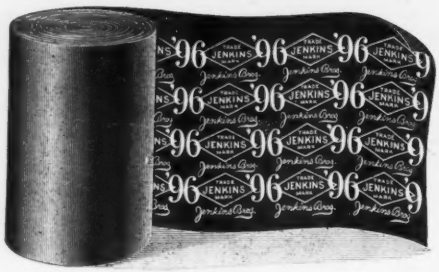
The Perfection of Joint Packing. Do not accept unless it bears our Trade-Mark as shown in the cut.



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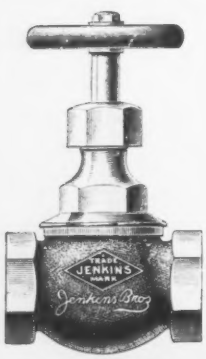

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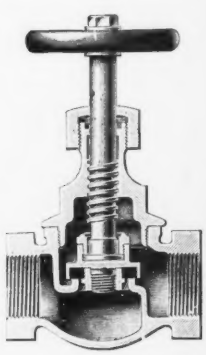

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Do not be deceived when you are offered discs "just as good" or better than the Jenkins, as many worthless imitations of our discs are on the market. We are the original manufacturers of this class of goods, and we have tried to maintain the high standard in which they are held by steam users throughout the world. Copper, Lead, Babbitt and all kinds of metal discs have been experimented with for the past twenty years, and in almost every instance, when under the action of steam, they become oxidized and hard, so that chip or scale getting between the disc and seat causes a leak, which necessitates regrinding. Insist on having the genuine Jenkins Discs; the difference in cost will not pay you to experiment. If you wish discs for any particular purpose, write to us; we can experiment cheaper for you than you can for yourselves. **Jenkins Discs will stand steam, oils or acids. We have special soft discs for cold water.**

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